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THE INSECT AND OTHER
ALLIED PESTS
OF
ORCHARD, BUSH AND Hothouse FRUITS

THE INSECT AND OTHER ALLIED PESTS

OF

ORCHARD, BUSH AND HOTHOUSE FRUITS

AND

THEIR PREVENTION AND TREATMENT

BY

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WITH ORIGINAL ILLUSTRATIONS

PUBLISHED BY THE AUTHOR
WYE COURT, WYE

1909

J.R.H.

LONDON :

PRINTED BY WILLIAM CLOWES AND SONS, LIMITED,
DUKE STREET, STAMFORD STREET, S.E., AND GREAT WINDMILL STREET, W.

PREFACE.

THIS book is written solely with the object of placing before fruit-growers, gardeners and amateurs an account of the insects, mites and worms which attack and cause disease amongst fruit trees, bushes, etc., both in the open and under glass.

Some mention is made of methods of prevention, even if they give only partial relief, and also of the various forms of treatment that have been adopted to destroy the insect and other enemies.

The volume is by no means complete, but it has reached such proportions that it is impossible to give all the information it was hoped to. Nevertheless, all the known pests to date and all those insect and allied creatures which have been recorded as having done damage are mentioned.

My thanks must be expressed to Mr. Robert Newstead, Mr. C. O. Waterhouse and Mr. W. F. Emptage for much valuable help during the writing of the work, also to so many fruit-growers that it would be invidious to mention names.

The photographs have mainly been taken for me by Mr. Edenden, and a few have been prepared by Mr. Blakey, Mr. Hammond, Mr. Tonge and Mr. Rintoul. Professor Felt of New York, Mr. Claude Fuller of Natal and Mr. Newstead have also kindly sent me photographs of Scale Insects and Fruit Fly damage.

A few figures have also been reproduced from my Reports issued from the S. E. Agricultural College.

The drawings have mostly been prepared by Mr. Horace Knight.

FRED. V. THEOBALD.

WYE, December 1908.

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THE INSECT AND OTHER ALLIED PESTS

OF

ORCHARD, BUSH AND Hothouse FRUITS.

INTRODUCTION.

SINCE Miss Ormerod wrote her valuable little handbook on ‘Orchard and Bush Fruit Insects’ in 1898, fruit-growing in this country has much increased and with it our knowledge concerning its enemies. Then and previous to it we had to rely mainly for information about insect pest treatment from our Colonial kinsmen and the Americans.

With the development of rational fruit-growing and its general stimulation has grown up from the times of Curtis and Westwood a desire to know more and more of the pests which harass the grower.

The life-history of an insect, mite or worm seems a trivial matter, but it takes much labour to unravel. Yet it is upon the knowledge of such matters that we must rely if we wish to fight this wonderful Nature which seems to us to do such incalculable mischief. The complete understanding of the vagaries of this or that insect pest may expose some vulnerable point where we can attack it with some possible hope of success.

Unfortunately we can lay no claim to complete, or anything like complete knowledge even of the best known of fruit pests. If any-one studies these beautiful, interesting, yet apparently unfriendly creatures, one can at once see what little we know about them. Any one of the best known may form a lifelong study, and even then we are far from the end. It is in this respect, this lifelong study of an insect pest, this specialism, that is followed so closely, so carefully by the school of economic biologists in our Colonies and America. Working assiduously, backed up officially, helped in all ways monetarily, they continue to make rapid and sound progress. In this country the so-called “science” of fruit-growing has taken enormous strides within the last fifteen years. The insect pests have grown with it one may say. To cope with them, methods for their

destruction have run as fast. To make up for so much lost time we have been taking impossible jumps, and it seems our fruit-growers who should benefit are those who suffer for the fall. The fruit-grower must place reliance in anything that scientific knowledge can give him, but he must not expect science to perform prodigies. At present it is only a little that the entomologist or chemist can do that can actually benefit the fruit-grower. They must go on building up knowledge, and here and there, as in medicine, it will lead to some definite success, some treatment that will cope with some particular disease.

After all the centuries of medical investigation, of medical treatment, of medical records, would any sane man be duped by a "quack" selling a pill or a bottle of mixture that is so complete it would cure all man's ills? Yet we seem to call to mind many who imagined a few years' work on totally unknown subjects had accomplished such an extraordinary thing in connection with plant diseases. The diseases of fruit trees, like those of man, must be treated according to their various ways, with the same wide variants; and for them we may say there are many palliatives, but few actual remedies. We have yet so much to learn, first of the diseases, then of how to treat them.

Methods of how to prevent and how to treat the diseases of fruit, caused by insect pests, are given in this volume. Many must be taken as mere suggestions, successful in one place but perhaps useless in another or under different circumstances. Can such treatment be called a "cure"? Time, material, environment, health of the treated trees have all to be taken into account. A certain dose of one particular drug for a certain man is good, it may be too much, or too little, or actually harmful to another. Is not this likely to be the same in the treatment of our fruit trees?

How can we best help the fruit-grower by "science," since he cannot, at this present decade, have a "consultant" always at hand. The only way is to enable him to tell what disease his trees or bushes are suffering from, and so to learn all he can about such a disease. Given this knowledge he can himself apply what known remedies we have, how and when the local circumstances seem best. It is with the object of placing before growers a condensed account of the numerous insects, mites, etc., that live upon and, we may say, cause disease to his trees and bushes that this book has been written.

It could never have been done had it not been for those very men whom the writer hopes to give some little help to, for the idea of how to see and how to follow these strange, yet beautiful insects, in

the field was first and is still too often stimulated and helped by them. Full use has been made of the many valuable notes not only of how we may check these enemies, but of their various ways, sent by many correspondents. The writer knows of several growers who could better have written this thesis, and probably many others have gone before who could have done the same.

The subject of spraying has not been dealt with at any length in this volume, but where it is of some, or even possible benefit it has been referred to and a general summary of the various washes in use is given in an appendix.* The author cannot help suggesting this advice—look upon the washing of fruit trees as only a small adjunct in fruit-growing. First, because we know as yet very little of any definite use; secondly, because great sums of money are too frequently wasted on washing healthy trees; thirdly, because so many of the washes used are harmful to the trees. What is the object of dosing a man with this or that drug as a remedy if he is well, unless it is to prove a “certain cure” to advertise some quack preparation. If one looks over any number of unhealthy fruit trees one can see at once very many unhealthy signs, many forms of actual disease, many sequela of diseases. How many of these are due to insect and fungoid enemies? There are probably just as many pathological diseases, stages and degrees of unhealthiness in plants as in man, and yet all we think of, all we try to cure with wonderful washes are the purely parasitical diseases.

Parasitology is most interesting, of enormous importance in human and animal as well as in plant disease, but we must not lose sight of the fact that it is only one factor in disease when we deal with fruit trees, as the doctor does with man and as the veterinary surgeon with animals.

With man and animals two things we notice in connection with parasites: first, dirty, unsanitary and unhealthy conditions encourage the unbidden guests; secondly, a weakened or diseased condition of the host predisposes it to these baneful enemies. So it is with our fruit trees; every grower knows that certain trees or varieties will not grow on certain lands, they become unhealthy and then they become cankered; he knows under certain other conditions they fail and become diseased.

An old, neglected, dirty orchard may often swarm with insect, mite, bacterial and fungoid pests. So do clean orchards when the

* For fuller information on various insecticides the reader is referred to ‘Fruit Trees and their Enemies, with a Spraying Calendar,’ by Spencer U. Pickering, M.A., F.R.S., and Fred. V. Theobald, M.A. (1908). Price 1s. 6d.

trees are unhealthy. Fruit trees are grown under most unnatural conditions, they are being forced to do unnatural things, they must become weakened. The result is they fall an easy prey to disease, whether it be pathological or parasitical. Is not the main thing to aim at to see to the general health of the trees, to their careful manuring and tending and cleanliness? Is this always done? Do not we let things struggle on until the plantation fails under its forced, unnatural living and so falls an easy prey to the parasitical enemies? All these are points for growers to consider. Certainly "science" ignores these factors in plant sanitation and seems to rush to insect and fungus, to bacteria and enzyme, and recommends washes or spray fluids, often as harmful as the pest one tries to destroy.

A great deal has been made of the benefit of treating apple and plum trees with lime and salt. Certainly great results have been obtained where the treatment has been properly carried out, as a means of checking the "apple sucker" and plum aphid.

Is this result due to any very definite action on the parasitical disease, or is it due to the production of a certain general healthiness in the trees and a concomitant resisting power to disease?

A healthy person resists disease better than one in a cachectic condition, and so it is with man's overcrowded, lacerated fruit trees.

First we must see to the general healthiness of our plantations, cultivation, manuring, judicious pruning and cleanliness. The prevention of insect and fungoid diseases embraces the latter. Two points only need be mentioned in that item of the fruit-grower's work, namely, the destruction *by fire* of all that we can that is diseased, of old and diseased trees, all winter and summer prunings, all diseased and unhealthy fruit; and, secondly, to see that all foul growth is kept from the trees by an occasional winter spraying.

One point the author must mention, in conclusion, namely, that of "natural enemies." The idea of "setting a thief to catch a thief" is one that we can scarcely look up to with great pride, but if one can only set that little murderous insect that destroys another with redoubled energy to work for man's benefit, of course it is a great achievement. There are two cases where this has been done with success, and the result has been that a school of thought has been formulated which claims that we have only to find the natural enemy of this or that parasite (even if we search the world), breed it, turn it loose and then, "hey presto!" the enemy has gone. Fortunately, this idea has not been received with favour in Britain, nor is it likely to be. We do not hope to live up to the ideal of seeing the fruit-grower (who can scarcely make his way against foreign competition

as it is) with hot-air chambers breeding races of ladybirds and chalcid flies ready to turn out when a particular insect appears in his plantation or fungus-loving cecids to destroy his mildew enemies. We sincerely hope and trust that those British fruit-growers, who yet grow the best fruit of certain kinds in the world, will leave these matters to that "school" elsewhere and follow the advice given by some of our chief colonial economic entomologists, and leave these insect parasites and feeders for Nature to do what she can with, of her own accord and where Nature rules, not man, and where the balance of life is natural and not completely upset, as it is in our fruit plantations.

The insect and fungoid diseases of fruit in Great Britain or elsewhere are at present known very little about, certainly of very few pests can we say we know enough of sufficient value to enable us to cope with them.

The object of this book, as previously stated, is to place before growers a *résumé* of some of the little we know. Unless they, for years to come, note and record what they see in their work—field facts—and unless we have much more pure naturalist work done we shall make but little progress. We must struggle on to collect the tangled skeins of the greater and then the minuter insect life before we can arrive at anything definite concerning the treatment of the majority of the pests or their prevention. The fruit-grower must help, both by recording his observations and his kindly criticism of what the economic biologist tries to do.

A SHORT SUMMARY OF THE CHARACTERS OF INSECTS AND THE ALLIED PESTS TREATED IN THIS VOLUME.

THE Animal Kingdom is well known to be divided into two groups, the so-called Vertebrata and the Invertebrata. To be more accurate, into what are known as Chordate and Achordate animals.*

The present volume deals only with the latter. It is hoped at a not far distant date to follow with a second volume of much smaller dimensions dealing with Vertebrate enemies, Animals and Birds.

The groups of invertebrata of economic importance to the fruit-grower are the Jointed-Limbed Animals or Arthropoda, the Snails and Slugs or Mollusca, and the Worms or Vermes. The majority of the injurious creatures come in the first group; the damage done by Slugs and Snails is very limited, and that done by Worms is almost exclusively confined to one family—the Eelworms which attack the strawberry.

A. The ARTHROPODA or Jointed-Limbed Animals can at once be told by the following characters :—

- (1) The body is divided into a number of rings or segments running in the longitudinal axis.
- (2) The appendages are composed of a number of joints, both those which are ambulatory and those which are sensory.
- (3) They develop by means of a more or less complicated series of stages, known as the metamorphosis.

B. The VERMES or Worms can at once be told from the former by the complete absence of jointed appendages in the form of limbs

* Those who wish to follow this subject of structure and classification more closely are referred to any modern text-book on zoology or my 'Text-book of Agricultural Zoology,' published by Blackwood & Sons. 8s. 6d.

and by the absence of that hard external skeleton seen in Arthropods and composed of chitin.

C. The MOLLUSCA or Slugs and Snails have normally a covering or shell composed of calcareous salts, and they have never jointed limbs or processes. The "Shell" may, however, as in Slugs, be rudimentary and internal.

A. The ARTHROPODA are divided primarily into the following classes :—

CRUSTACEA (Crabs, Lobsters, Woodlice, etc.), mainly aquatic animals, but Woodlice are terrestrial. The head bears two pairs of jointed feelers or antennæ, and there are organs of locomotion on most of the segments of the body. The young in the Woodlice closely resemble the parents. They breathe by means of gills.

MYRIAPODA (Millepedes and Centipedes). Terrestrial. Head separate from the rest of the body, which is composed of a number of rings each of which bears one pair (Centipedes) or two pairs (Millepedes) of legs. The young resemble the parents. In millepedes the first three segments have each only one pair of legs. The young are hexapod, but the legs are never all on the first three rings.

ARACHNOIDEA (Spiders, Mites, etc.). These have either eight legs attached to the front part of the body (thorax) or two pairs (Gall Mites). The young or larvæ are usually six-legged (hexapod), and thus differ from the adults. The body is, however, never divided into three marked regions.

This class is subdivided as follows :—

a. *Araneida* (Spiders).

Legs eight. Breathe by means of air sacs and trachea. Head and mid body or thorax united, forming a so-called cephalo-thorax. Eyes simple. Abdomen not ringed. All beneficial.

b. *Acarina* (Mites and Red Spiders).

These have thorax and abdomen more or less in one, and breathe cutaneously and by trachea. The young are six-legged. Ticks are also included here.

HEXAPODA (True Insects).

Easily told by having the head, thorax and abdomen distinct from one another, and by having six legs.

8 *Summary of the Characters of Insects, etc.*

This class is divided into the following smaller groups called orders :—

- a. *Coleoptera* (Beetles). Wings four, the upper pair hard and horny (elytra). A biting mouth present.
- b. *Lepidoptera* (Butterflies and Moths). Four wings, more or less covered with scales. Mouth suctorial.
- c. *Hymenoptera* (Ants, Bees, Wasps and Sawflies). Four membranous wings, few veins. Mouth biting and suctorial.
- d. *Diptera* (True Flies). Wings two only; the second pair reduced to two club-shaped processes called halteres or poisers. Mouth piercing or suctorial.
- e. *Hemiptera* (Bugs, Scale Insects, Plant Lice). Wings four. Mouth piercing and suctorial. The front wings may be leathery at the base (hemi-elytra) in Bugs (Heteroptera), or all transparent, as in Plant Lice (Homoptera), or absent (Scale Insects).
- f. *Neuroptera* (Lace-wing and Dragon Flies). Wings four; more or less uniform, with a network of veins. Mouth biting.
- g. *Orthoptera* (Locusts and Grasshoppers). Wings four; front pair more or less leathery, veins more or less straight; hind pair fan-shaped, with radiating and concentric veins. Mouth biting.
- h. *Thysanoptera* (Thrips). Wings four; very narrow, fringed all around with hairs. Mouth weak, biting.
- i. *Aptera* (Springtails, etc.) No wings. No life changes.

The first four undergo what is called *complete metamorphosis*, that is, there are the following stages during growth :—

- (1) The ovum or egg.
- (2) The larva (caterpillar, maggot or grub).
- (3) The pupa or chrysalis.
- (4) The sexual adult.

The third stage is the one in which the active, sexless larva is transformed into the sexual adult, the period when the caterpillar is transformed into the moth. It is a period of rest and complete change; the pupa is unable to crawl or fly or feed, a quiescent period when most of the organisation of the larva is broken down and reformed.

The groups or orders e to h undergo what is called *incomplete metamorphosis*. Here we have the same stages, namely, egg, larva, pupa and adult, but the pupa is active and feeding. Growth and

development takes place gradually, and there is no abrupt change as seen between the larva and the adult in the moth or fly.

The final group (*i*) undergo no metamorphosis.

B. The Worms or VERMES are divided into three main groups :—

- (1) Platyhelminthes or Flat Worms.
- (2) Nemathelminthes or Round Worms.
- (3) Annelida or Segmented Worms.

So far only some of those belonging to the Nemathelminthes are known to be injurious to fruit. But it is possible that the Annelid worms, the *Enchytræidæ*, which are parasitic on other plants, may occur on the roots of ground fruit.

The injurious Round or Nemathelminth Worms belong to the sub-order Nematoda, and have filiform bodies, the two ends being more or less pointed, and the posterior end of the male, which is usually smaller than the female, slightly curved; they are round in section, their skin smooth or slightly wrinkled, and the sexes are separate.

The plant parasites belong to a family of Nematoda known as *Anguillulidæ* or Eelworms, which are small, microscopic, thread-like worms. These nematodes live both free in the soil and in the tissues of plants, and others in decaying vegetation. Those which attack plants, and also which are found in decaying plant tissues, have a boring spine. The sexes are separate, and the female produces large eggs.

Enchytræidæ are a family of Annelid worms of small size, never more than 1 inch or so in length, and sometimes found in masses around the roots of plants, and are of a white colour.

C. MOLLUSCA of importance are confined to the order *Gasteropoda*. Two families of this order attack fruit, namely, Snails (*Helicidæ*) and Slugs (*Limacidæ*).

The Helicidæ have a shell into which the snail not only can withdraw its body, but which can be closed up at the entrance by means of a structure called the epiphragm.

The Limacidæ have a very weak shell buried under the skin.

Both produce eggs, and the young are like the parents.

INSECTS
INJURIOUS TO THE APPLE.

THE MORE IMPORTANT INSECTS FEEDING ON APPLE.

A. LEPIDOPTERA.

- THE LARGE TORTOISESHELL BUTTERFLY (*Vanessa polychloros*. Linn.).
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- THE EYED HAWK MOTH (*Smerinthus ocellatus*. Linn.). Foliage, p. 15.
- THE APPLE CLEARWING (*Aegeria myopiformis*. Bork.). Bark, p. 17.
- THE LAPPET MOTH (*Lasiocampa quercifolia*. Linn.). Foliage, p. 19.
- THE BROWN TAIL MOTH (*Euproctis chrysorrhæa*. Linn.). Foliage,
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- THE GOLD TAIL MOTH (*Porthesia similis*. Fues.). Foliage, p. 27.
- THE LACKEY MOTH (*Clissiocampa neustria*. Linn.). Foliage, p. 30.
- THE DECEMBER MOTH (*Pacilocampa populi*. Linn.). Foliage, p. 34.
- FIGURE-OF-8 MOTH (*Diloba caeruleocephala*. Linn.). Foliage, p. 35.
- VAPOURER MOTH (*Orygia antiqua*. Linn.). Foliage, p. 38.
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- PEPPER AND SALT MOTH (*Amphidasya betularia*. Linn.). Foliage, p. 64.
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- OTHER TORTRICES } *(Tortrix podana*. Sc.). }
} *(Tortrix rosana*. Linn.). }
} *(Sideria achatana*. Fab.). } Foliage and buds,
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- THE BUD MOTH (*Hedya ocellana*. Fab.). Buds and young flowers and
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- SMALL ERMINE MOTH (*Hyponomeuta malinella*, Zell.). Foliage, p. 86.
- PITH MOTHS (*Blastodaena hellerella*, Dup., and *Blastodacna vinolentella*,
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 ROSE CHAFER *Cetonia aurata*, Linn.). Foliage and Blossom (*Vide Raspberry*).
 COCK CHAFER (*Melolontha vulgaris*, Fab.). Foliage and roots (*Vide Raspberry*).
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THE EYED HAWK MOTH.(*Smerinthus ocellatus.* Linn.)

The large caterpillars of this beautiful Hawk Moth are sometimes reported from apple trees, upon which their presence is soon detected by the great amount of foliage they devour and the large pellets of "frass" dropped by them.

The damage done may be serious if numbers occur. Miss Ormerod (1) records these larvae as stripping the leaves of apples at Bewdley, her correspondent saying, "The caterpillar is very destructive"; another communication from Meldrith, Cambridgeshire, stated, "They entirely denude the trees of all their leaves."

They have been sent me from several places in Worcestershire, Suffolk, Kent and Surrey, with notes regarding the damage they have done. The damage is more apparent than real. Knowing, however, the ravenous habits of the Hawk Moth caterpillars when young, it is not unlikely that any undue increase might lead to much loss occasioned by the young larvæ.

The chief food plants are willow, sallow and poplar, but they also occur on sloe, peach and almond.

DESCRIPTION AND LIFE-HISTORY.

The moth measures from $2\frac{1}{2}$ inches to nearly $3\frac{3}{4}$ inches in wing expanse (Fig. 1).

The fore wings are of a rich grey-brown, with pale chocolate or olive-brown markings, a median bar being noticeable; the hind wings are rosy-red, becoming rather greyish at the edges, and with a large greyish-blue eye-spot on each, encircling a black pupil and surrounded by black, as seen in Figure 1; the broad thorax is dark in the middle, greyish-brown at the sides, and the abdomen is also greyish-brown.

The moth frequents gardens and orchards, but especially osier beds and willows.

It appears from the end of May until the middle of July, and may be found all over England, but is rare in Scotland. The ova are laid singly on the leaves. The egg is plump and oval, the upper surface shrunken in the middle, the shell shiny, but finely reticulate; in colour it varies from pale-greenish to yellow.

The larvæ may be found in the months of June, August and September, the majority in the last two months.

When mature the larva is 3 inches long; in colour it is

green, sometimes bluish-green, at others bright apple-green, minutely dotted with white and with eight white or pale yellow diagonal bars on each side, bordered above with darker colour; the tail is light blue, the apex being deep green, reddish-brown or black, rarely uniform blue; the spiracles are yellowish-white, edged with brown.



[F. Edenden.
FIG. 1.—THE EYED HAWK MOTH (*Smerinthus ocellatus*, Linn.)
Adult, larva and pupa.

The length of larval life is about six weeks. They then enter the soil and make a cavity about 2 inches deep. The pupa is deep brown, and measures often $1\frac{3}{4}$ inch; in this stage the Eyed Hawk remains throughout the winter and spring.

TREATMENT.

All that is necessary as far as present attacks have gone is hand-picking the caterpillars. Should they ever occur in such large numbers as I have seen them in osier beds in Middlesex and Huntingdonshire, then spraying with arsenate of lead would prove successful.

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- (1) *Ormerod, E. A.* Report of Observations of Injurious Insects, etc., during the year 1894 (18th Report) p. 1 (1895).
- (2) *Buckler, W.* 'The Larvæ of British Butterflies and Moths,' vol. II., pp. 99-108 (1887).

THE APPLE CLEARWING.

(*Egeria myopiformis.* Bork.)

On the 21st of June, 1907, larvae and pupæ of this Clearwing Moth were sent me from the Croydon district by the Secretary of the Horticultural Mutual Improvement Society (3).

The larvæ were taken out of an apple tree, Warner's King, where they had been working havoc underneath the bark. They occurred in patches. In many instances they were found in the wounds caused by Woolly Aphids.

"The attacked trees are about six years old," wrote the Secretary, Mr. Boshier, "and are in good bearing condition."

On the 26th of June a further lot of pupæ were sent, taken from Duchess Favourite, Warner's King, Colonel Vaughan and Winter Queening. The larvæ were mostly found about 7 feet from the soil.

This Clearwing Moth (Fig. 2) is somewhat similar to the Currant Clearwing in general appearance, but can at once be told by the broad red belt on the abdomen. The length is about 20 mm., with a wing expanse of 22 to 25 mm. The head, thorax and body are black; the latter has a bright red band above, white beneath in the male; in the female the underside is only edged with white; the tail fan is black. The wings are transparent, with dark sealed areas. The moths fly by day, and are found in May, June and July.



[F. E.
FIG. 2.

THE APPLE CLEARWING MOTH.
(*Egeria myopiformis.* Bork.)

LIFE-HISTORY AND HABITS.

They frequent gardens and orchards, and lay their eggs almost exclusively on apple trees.

Wood (1), in his 'British Moths,' says they are "said to feed on the small stems and twigs of the apple tree."

This does not appear to be always the case, for the trunks only seemed to be attacked at Croydon.

The moth lays its eggs on the trunk of the tree and the larvæ tunnel under the bark; there they work until they are mature, and then they eat out a hollow in the wood, which they line with silk of a dull grey colour, and cover the outside with brown wood chips.

The larva is dull yellowish-white. Buckler (2) describes a pinkish pulsating dorsal vessel, with an internal purplish-pink tinge from segments five to eight; this could not be detected in the specimens sent me. The head is retractile and shiny reddish-brown; the second segment is somewhat wider than the others, and has a brown dorsal shield; the segments are very distinct, and the prolegs



FIG. 3.—COCOONS AND PUPÆ OF THE APPLE CLEARWING (*Egeria myopiformis*. Bork.).

small and very inconspicuous; there are traces of spots, each terminated by a bristle. The specimens sent were mature, and measured a little more than $\frac{3}{5}$ inch in length. The whole larva seems rather flattened. The mature larvæ were very sluggish when extracted from their irregular burrows. They had all pupated by the 29th of June.

The pupæ (Fig. 3) are bright pale brown, and lie completely protected in the silken cases covered with rich brown wood chips and apparently some "frass" from the larval workings. In length the pupæ varied from a little over $\frac{1}{3}$ to nearly $\frac{1}{2}$ inch.

They were all curved and slender, and tapered to a point at the apex, which is bluntly rounded with a ring of spines; the first five abdominal rings have two dorsal rows of spines, the two following, one row each. The spines are somewhat darker than the ground colour.

When ready to hatch, the pupæ make their way partly out of the cocoons, and the empty brown skins are seen protruding from the trees.

TREATMENT

can only be of very doubtful benefit, as the larvae are difficult to get at, but it is said that a sticky dressing smeared up the trunks in May easily checks the egress of the moths, and prevents further egg-laying.

REFERENCES.

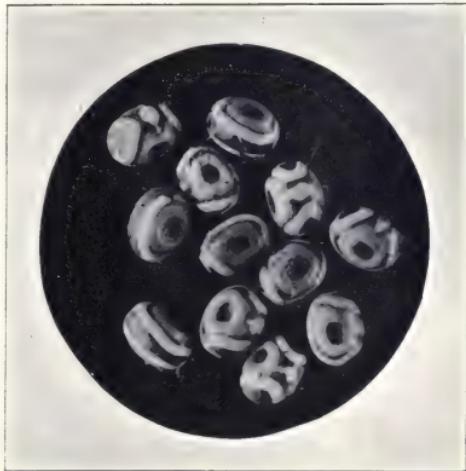
- (1) *Wood, F. O.* 'Natural History of British Moths,' vol. I., p. 18. Pl. 5, fig. 5 (1872).
- (2) *Buckler, William.* 'The Larvæ of British Butterflies and Moths,' vol. II., pp. 128-129. Pl. xxix., fig. 1 (1887).
- (3) *Theobald, F. V.* Report on Economic Zoology for year ending April 1st, 1907, p. 20 (1907).

THE LAPPET MOTH.

(*Lasiocampa quercifolia.* Linn.)

This is another handsome moth which now and again is sent by orchardists, owing to its large and strange caterpillars devouring such quantities of foliage. Fortunately, it is not very common and certainly cannot be looked upon as a pest. The quaint and active pupae in the cocoons are also frequently sent. Numbers have been brought me by hedge-trimmers who have noticed them moving, and taken them for mice, the mouse-coloured cocoon having led to this mistake. The ravenous larvae destroy the leaves of apple and plum in orchards and gardens, often stripping whole shoots and boughs.

Miss Ormerod refers to it (1), but I know of no other record of it as causing annoyance. It occurs fairly commonly over the Midlands, eastern, western and southern counties of England.



[W. H. Hammond,

FIG. 4.—EGGS OF LAPPET MOTH. (× 20.)

Its food plants are the apple, plum, pear, hawthorn, blackthorn, willow and sallow.

LIFE-HISTORY AND HABITS.

The moth appears at the end of June and in July. It varies in length, the male being much smaller than the female; the latter is often $3\frac{1}{4}$ inches from wing to wing, the male seldom more than $2\frac{1}{4}$. The form is shown in Figure 6, page 21; the colours are rich brown, with irregular dark transverse scolloped lines, the posterior wings

very similar, and both pairs have scolloped edges. When at rest the under wings project in a characteristic manner beneath the upper. The eggs (Fig. 4) are very marked.

The larvae hatch in late summer and autumn, and hibernate during the winter. Previous to this they moult once, and then remain extended on a twig (Fig. 5) and assume the colour of the wood. The mature larvae reach over 4 inches in length, they are grey and grey-brown in colour with faint V-shaped dark marks or other indistinct ornamentation down the back; always present, however, are two beautiful deep blue or purple, velvety bands across the segments next the head. Above the legs on each side and on all the segments is a row of fleshy



FIG. 5.
[F. Edenden.]

YOUNG LARVAL LAPPET READY FOR WINTERING.

pad-like appendages with long grey hairs, like lappets, and hence the name "Lappet Moth"; there is a more or less prominent hump on the last but one segment, and all the body is finely hairy (Fig. 6 B).

When mature in summer the caterpillar spins a long oval cocoon, pointed at each end, in all I have seen, and of a mouse colour, hairs being mixed with the silk. This cocoon is spun up amongst the

twigs of the trees, in crevices in bark and amongst rubbish on the ground. The large dark brown pupa is very motile, and moves with such vigour that the cocoon shakes and even moves along an even surface.

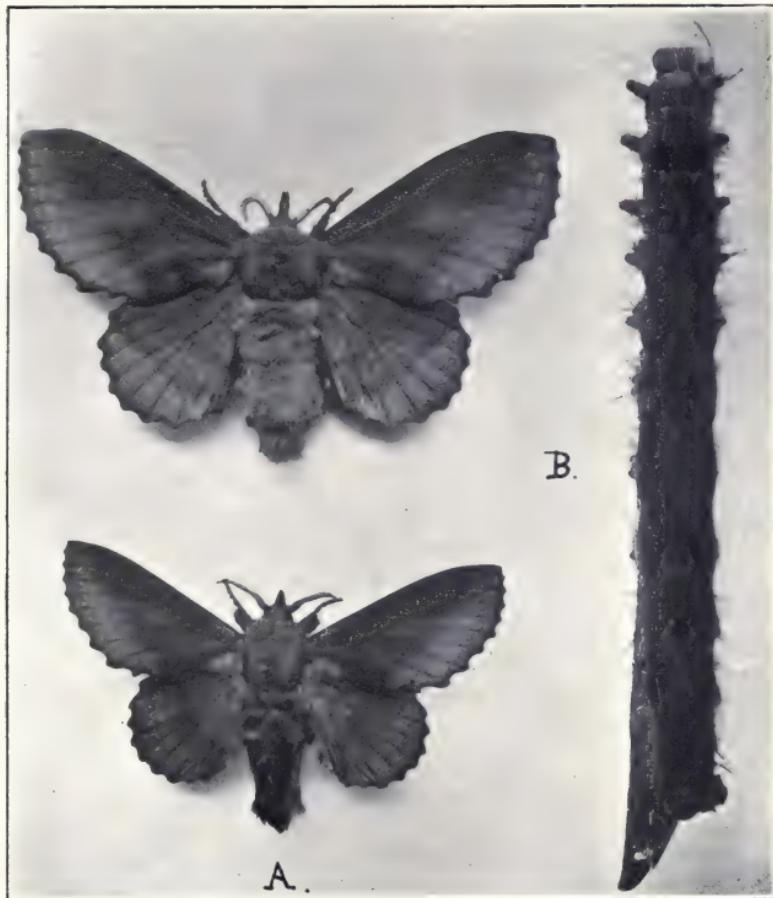


FIG. 6.—THE LAPPET MOTH (*Lasiocampa quercifolia*, Linn.).

[F. Edenden.]

A, female and male; B, mature larva.

TREATMENT.

If this curious moth becomes sufficiently abundant in plantations it could be easily kept from doing harm by arsenical spraying. So far, all that is necessary is hand collection.

REFERENCES.

- (1) *Ormerod, E. A.* 'Handbook of Insects Injurious to Orchard and Bush Fruits,' p. 24 (1895).
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THE BROWN TAIL MOTH.

(Euproctis chrysorrhœa. Linn.)

This moth is a common British insect, and its presence in America is only too well known on account of the vast amount of harm it is doing there. It appears to have been accidentally introduced into New England some seventeen years ago on rose bushes from France. Since then it has rapidly spread, and has not only caused damage over a large tract of country, but appears to be still on the increase. Besides being found in Britain, this insect is common on the Continent, and extends eastwards as far as the Himalayas and as far south as Algeria.

According to Stainton (1), the Brown Tail Moth is local. Where it does occur, however, it may become very abundant. It belongs to the family of moths known as *Liparidæ*, and is closely related to the Gold Tail, but has many divergent traits in its life-history.

One of its curious features is that it may occur one year in enormous numbers and then completely disappear. In Kollar (2) is recorded the following:—"In the summer of 1782 this insect created great alarm over the country from its multifarious colonies which were so immensely numerous, we are informed by Mr. Curtis, that in many of the parishes near London subscriptions were opened and the poor people employed to cut off the webs at one shilling per bushel, and which were burnt under the inspection of the churchwardens, overseers or beadles of the parish."



[F. Estenden,
FIG. 7.]

WINTER TENT OF BROWN TAIL MOTH
AND YOUNG LARVAE OUTSIDE.

Prayers were even offered up in some of the churches to deliver the country from the apprehended approaching calamity (3).

It occurred in enormous numbers in East Kent in 1901, next year it was scarce, and since then it has been very difficult to find "tents" of these caterpillars.

Amongst localities where it has been or is found may be mentioned Epping, Lewes, Tenterden, Ramsgate, Canterbury, Wye, Sittingbourne, Faversham, Hythe, Ashford, Linton, Teignmouth, Bristol, Lymington, Newmarket, Bisterne, Norwich, Stowmarket, Black Park, Dorking, etc.

The damage done by these tent-forming caterpillars is very similar to that done by the Lackey Moth.



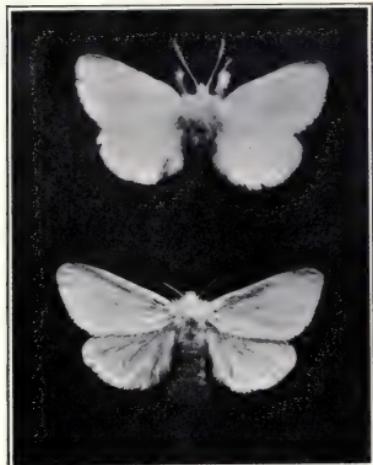
FIG. 8.

ANOTHER NON-HANGING WINTER
TENT (A) AND EGG-MASS (B).

(Half natural size.)

LIFE-HISTORY AND HABITS.

The female moth (Fig. 9) has pure satiny white fore wings with a faint dusky spot on each; hind wings pure white; the head, thorax and abdomen pure white; a dense brown to golden brown pad-like tail tuft, and the brown colour may spread on to a few segments of the abdomen; the male has no dusky spots on the front wings, and the brown tail tuft is much smaller and more fanlike. The wing expanse varies between $1\frac{1}{2}$ inch and $1\frac{3}{4}$ inch. The moth is a night-flyer, and may be found resting by day on walls, leaves, lamps, etc., and is very sluggish, falling down as if dead when its resting-place is shaken.



[F. Edenden.
FIG. 9.]

MALE AND FEMALE BROWN TAIL MOTHS.
(Natural size.)

The female lays her eggs on the under surface of the leaves. These are placed in a long mass reaching

sometimes an inch in length; these long egg-masses are covered over by the hairs from the female's tail, the eggs being completely hidden. The ova are round, of a dull golden hue, and as many as two hundred and fifty may occur in each batch. They are not only laid on apple, pear and plum, but also on oak, elm, blackthorn and whitethorn.

The larvae hatch out from the beginning of August and live on throughout the winter. At first they are very small, of a dirty yellow colour, with black head and four rows of black dots and numerous hairs. They at once bend over and spin a single leaf together, eating only the epidermis, and at the same time they attach the leaf to the twig by a mass of silk, so that it cannot fall off.

Towards September they commence to make a regular nest of dull grey silk, attaching several leaves together in the process; these

dead leaves become lined and covered with silk and are all firmly united.

This nest (Figs. 7 and 8) remains on the trees all the winter. In September the larvae moult and still feed on as long as the leaves contain any sap. This small nest they use as a protection in damp weather and at night. Even after the leaves have gone it is not unusual to see the small larvae basking in the sun outside their tent. As the weather becomes colder they become dormant.

The hardest frosts do not seem to

FIG. 10.—PART OF EGG-MASS AND LARVA OF BROWN TAIL MOTH.

and remain in their dwellings.

In the spring they commence to feed on the leaves as they open, the young larvae wandering some way from their nest. Very frequently a colony will divide, two nests being made and sometimes even a third is formed.

Early in May they moult again, and assume a deep brown colour with reddish-brown hairs, a row of white spots on each side, a narrow double broken line of red on the back, dark between, and with two prominent bright red tubercles on the back of the eleventh and twelfth segments; these two tubercles are depressed in the middle and can be elevated or withdrawn at will by the caterpillars. Their object is unknown. If it is to frighten off enemies they are useless, for the Brown Tail Moth caterpillar in this country is subject



to much parasitic infestation. After the last moult the caterpillars spread out over the fruit trees.

They then seem to forsake their nest, and they devour the leafage wholesale.

From the end of June to the beginning of July they spin cocoons amongst the leaves of the fruit trees, as a rule several together forming a large mass united by a dusky web. In their cocoons they change to deep brown pupæ. Kollar (2) says as many as twelve cocoons may be gathered into one ball.

Some years ago I counted as many as forty on a damson tree in one mass (4). From these pupæ the moths come out in the latter part of July and in August, and soon begin to lay their long egg-masses.

NATURAL ENEMIES.

Kollar (2) records both the eggs and the larvæ attacked by Ichneumon flies. These parasites, which are apparently common on the Continent, do not occur, as far as we know, in Britain. They are considered important by American entomologists, who are introducing them into the States. Howard (5) tells us that many thousands have been introduced and released in the vicinity of Boston.

The only abundant parasite that I have come across in Britain is a Tachinid fly, *Thelymorphia vertiginosa*, Fl. This fly appeared in great numbers in 1901, and I feel sure had a large share in stamping out this moth (6).



FIG. 11.—TOP OF A "TENT," WITH NEARLY MATURE LAR.V.E.

BROWN TAIL CATERPILLAR RASH.

The hairs of the Brown Tail caterpillar are very finely barbed and also brittle. If one touches a caterpillar these hairs stick in the skin and break off, and cause very severe irritation in the form of a distinct rash.

Moreover, when the insect occurs in large numbers, much inconvenience is caused by the hairs, broken off at moulting time or when the cocoons are being formed, blowing about in the air. They then not only settle on the face but get into the mouth, eyes, etc., and cause very great annoyance and some danger to the afflicted person. The worst urticating hairs are those short brown ones from the tubercles on the back and sides.

Howard (5) describes very bad symptoms resulting from these hairs in America.

The best remedy to apply when one has been covered with these hairs is the following:—Carbolic acid $\frac{1}{2}$ drachm, zinc oxide $\frac{1}{2}$ oz., lime water 8 oz.

PREVENTION AND REMEDIES.

The winter tents (Figs. 7 and 8) should be sought for and burnt; as they are easily seen this is not a difficult task. Any "tents" that show in early summer should also be destroyed either during a wet day or towards evening. It is advisable to hold a sheet under the tents when being cut off in the summer, in case any of the caterpillars fall.

Should these caterpillars appear unawares in a plantation the whole should be sprayed with arsenate of lead.

REFERENCES.

- (1) *Stainton, H. T.* 'Manual of British Butterflies and Moths,' I., p. 134 (1857).
- (2) *Kollar, Vincent.* 'A Treatise on Insects, etc.' Eng. Trans., p. 190 (1840).
- (3) *Curtis, John.* 'History of the Brown Tail Moth' (1782).
- (4) *Theobald, F. V.* Tent Caterpillars, Board of Agriculture Journal, Sept. (1901).
- (5) *Howard, L. O.* The Brown Tail Moth, and how to Control it. Farmers' Bulletin, No. 264. U.S. Dept. Agri. (1906).
- (6) *Theobald, F. V.* Report on Economic Zoology for year ending April 1st, 1907, p. 25 (1907).

THE GOLD TAIL MOTH.

(*Porthesia similis*. Fues.*)

The caterpillar of this moth is often very harmful, not only to hawthorn hedges, but also to fruit trees throughout the country at certain times.

It occurs on apple, plum, pear, cherry, nuts and roses. The pretty caterpillars devour the foliage. The chief harm is done by the young larvæ when they come from their winter quarters, for they feed ravenously on the tender leaves.

This beautiful moth, with pure satiny white wings, is found settled with its wings folded downwards on leaves, palings, lamps, etc., in August. In the male is noticeable a dusky spot on the inner border of the fore wings. Thorax and abdomen are pure white, but the latter has a golden yellow tail tuft. In size the male varies from 1 inch to $1\frac{1}{4}$ inch, the female up to $1\frac{3}{4}$ inch.

LIFE-HISTORY AND HABITS.

The life-history may be briefly summed up as follows: The moths lay their eggs in August on apple, plum, pear, cherry, hawthorn, hazel, cob, oaks, Spanish chestnut (3), roses and other trees. The eggs are laid in golden coloured nests of hairs derived from the female "tail." They hatch in some seven to ten days, and the small larvæ feed upon the leaves until the autumn, during this time they moult once (Taschenberg (2) says twice).

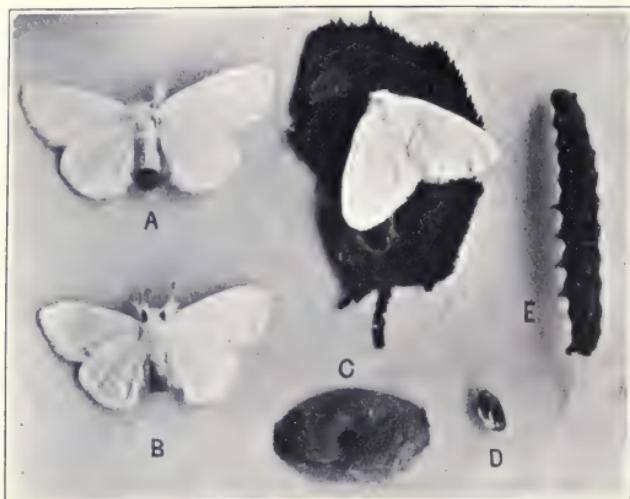
As soon as the leaves harden, these little caterpillars at once go into winter quarters. They seek out shelter in bark crevices, under the bark scales, under moss and lichens, and in various holes. Here they spin small dull grey cocoons about $\frac{1}{4}$ inch in length, and remain hibernating during the winter. Although they appear to be solitary, yet numbers will collect in any suitable place of shelter.



[F. Edenden.
FIG. 12.—GOLD TAIL MOTH AT REST.
(Slightly enlarged.)

* Also known as *P. auriflua*. Fab.

In spring they come forth as soon as the buds swell, and commence to feed on the young leaves. Some sent from Evesham came



[F. Edenden.]

FIG. 13.—THE GOLD TAIL MOTH (*Porthesia similis*).

A and B, female and male ; C, summer cocoon ; D, small winter cocoon ; E, larva.

out of their small cocoons on the 18th of March. They continued feeding until July, but many matured in the latter part of June.

The larva is deep brownish-black, with a bright red dorsal stripe, a red line on each side spotted with white, and another above the legs. The segments have tufts of brown hairs.



[A. V. D. Rintoul.]

FIG. 14.—YOUNG GOLD TAIL LARVA ON PLUM LEAF.

When mature it spins up in a grey cocoon with larval hairs in its meshes, and changes to a deep brown pupa ; these are usually

formed on or near the food plants, sometimes between leaves, at others on the bark or between the forks, or on palings, etc., near by.

There seems something wrong with the account of this insect given in the English translation of Kollar's 'Treatise on Insects Injurious to Farmers,' etc., by J. and M. Loudon, for on page 199 they speak of *P. auriflua* as the Brown Tail Meth, and on page 190 *P. chrysorrhæa* is put as the Gold Tail (1).

The popular names are most appropriate if rightly applied, and this error is pointed out in case that interesting little German work falls into the hands of those who are not fully acquainted with the insect's economy.

The Gold Tail does not form a web at all, the larvæ feed solitarily, but the Brown Tail (*P. chrysorrhæa*) does.

That it is of frequent annoyance we know, but the damage done when the larvæ are large is comparatively slight, compared with the little known harm caused by it in the young stage in the spring, which we can easily check.

PREVENTION AND TREATMENT.

This consists of catching the larvæ by enticing them to some comfortable winter quarters, such as has been found in the banding adopted for Codling Moth prevention. Mr. Small of Evesham (4) forwarded me many of the small winter cocoons found under the sacking placed to catch Codling Moth, and such has been reported by several other correspondents. These bands and the collected larval cocoons can be burnt in winter with the Codling Maggots caught by them. The caterpillars, when appearing in any numbers, can be killed very readily by spraying with arsenate of lead, which has been found much more effective than Paris green for this species.

The only bird that feeds upon these larvæ is the Cuckoo.

REFERENCES.

- (1) *Kollar, Vincent.* 'A Treatise on Insects Injurious to Gardeners, Foresters and Farmers,' p. 199 (1840).
- (2) *Taschenberg, E. L.* 'Praktische Insekten-kunde.' Die Schmetterlinge. (Dritter Theil), p. 95 (1880).
- (3) *Theobald, F. V.* Insects attacking the Spanish or Sweet Chestnut. Journal South Eastern Agricultural College, No. 8, p. 47 (1899).
- (4) *Theobald, F. V.* Report on Economic Zoology for the year ending April 1st, 1907, p. 22 (1907).



FIG. 15.

PEAR FRUITLET
EATEN BY GOLD
TAIL LARVA.

THE LACKEY MOTH.*(Clissicocampa neustria. Linn.)*

The Lackey Moth belongs to the family Bombycidæ, more or less hairy moths, the males having pectinated antennæ, the females thread-like ones.

This moth is widely distributed over the south, west and middle



FIG. 16.—NESTS OF LACKEY MOTH.
(One-fifth natural size.)

[F. Edenden.]

of England, but is most abundant in the south and west. It does not seem to occur further north than York, where it is uncommon. In the south of England it is always more or less common in our plantations, but at certain times it appears in enormous numbers, especially in apple and pear orchards, where it strips the foliage. Only last year a vast concourse of them appeared in the Sittingbourne and Faversham areas of Kent and carried all before them, one grower stating that he could collect them by bushels. Carpenter (1) records it from Ireland. It is particularly common in France, where there are laws compelling growers to cut off and destroy the "tents" and the larvae. Guerin Meneville states that it is one of the most injurious fruit and forest tree pests in France. Kollar (2) gives an account of it, and says that it is troublesome in Germany.

Unfortunately it feeds on hawthorn hedges and in woods, and being capable of moderate powers of flight, it is thus always liable to invade our orchards and gardens.

LIFE-HISTORY AND HABITS.

The moth (Fig. 18) is very variable in size and colour, and measures about 1 inch in expanse of wings in the male and $1\frac{1}{2}$ inch in the female. The front wings are a rusty reddish-brown, ochreous or brick-dust red, with two pale or dusky transverse lines across them, the space between the two bars being often more deeply coloured than the rest of the wings; the hind wings are the same tint as the fore, but often a little paler.

The moth occurs in July and August, and a few stragglers may be found in September.

The females deposit their eggs in rings or bands, and usually choose the year's growth of wood. Each band contains from forty up to two hundred eggs. The bands are shown in Fig. 17. When the wood shrinks they may become quite loose and turn round and round, but at other times they may be found tightly gummed to the shoots. In colour they are dull grey to greyish-brown, with a small



FIG. 17.—EGG BANDS OF LACKEY MOTH.

Young hatching out on right.

(Twice natural size.)

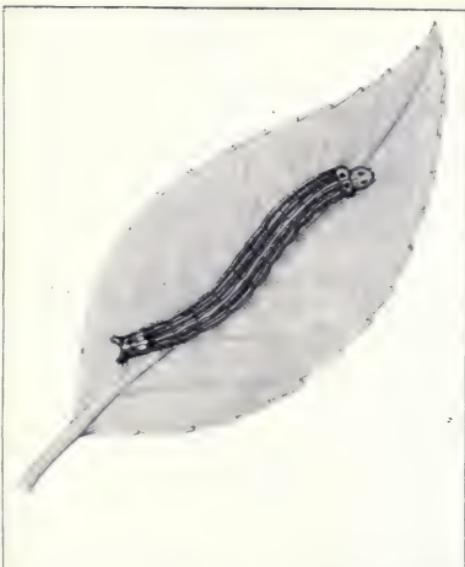


[E. Tonje.]

FIG. 18.—FEMALE AND MALE LACKEY MOTHS.

as they grow, being bluish-grey, with two black spots on the segment next the head and also two on the bluish-grey head; three orange-red stripes run along each side, and between the two lowest of these is a broad blue stripe with little black specks, these brilliant lines being separated by black and black spotted with blue; a pure white line runs down the back, with a narrow dark line on each side. The whole larva has upon it rather rusty hairs, which are darker above than at the sides. When full grown the caterpillar reaches $1\frac{1}{2}$ inch in length. On warm days they may often be found in batches, several lying parallel to one another, either on

dark central depression, and are readily seen on the shoots. About the end of April they hatch out. The young caterpillars are quite dark at first and somewhat hairy. Very soon they commence to form a web of fine silk, enclosing a few leaves, and beneath this they continue to feed for some time. As they grow, the silken house is enlarged until it may reach over a foot in length. At first the larvae seem to feed entirely under the tent, but as they grow they spread out over the trees and feed upon the foliage, returning to their web at night and in dull wet weather. They become brilliant coloured



[Horace Knight.]

FIG. 19.—CATERPILLAR OF LACKEY MOTH.

(Not quite full grown.)

the outside of the tent or along the branches. They are somewhat timid and fall to the ground on the tree being shaken, but soon crawl back to the foliage again.

Maturity is reached from the middle of June to the end of July, when they disperse and spin cocoons of loose pale silk; mixed with it are a number of hairs and a yellowish powder.

The cocoons may be spun singly amongst the leaves, or on fences, etc., or, as seen in Fig. 20, a mass of them together. In the cocoon the larva changes to a dark brown pupa, from which the moth hatches in two or three weeks.

The food plants are very varied, such as oak, elm, hawthorn and roses being their favourites, besides the fruit trees mentioned.

PREVENTION AND REMEDIES.

Many of the egg bands are naturally cut off by pruning, and these of course should be burnt. As the egg bands are readily seen, it would be advisable after an attack of Lackey Moth to go over the plantation and see that all of them are destroyed in winter. Spraying with arsenical washes has been found of great benefit, and the early destruction of tents should always be seen to. For this we can use long-handled pruners, and care should be taken to see that all the caterpillars are destroyed. Where large trees are attacked and spraying is not possible, an excellent plan is to have the larvae shaken down. Thick grease bands placed around the trunks of the trees will stop those which are not killed on the ground from ascending again.



[F. Edenden.]

FIG. 20.—COCOONS OF LACKEY MOTHS AND JUST HATCHED ADULTS.

NATURAL ENEMIES.

No insect parasites are of any value in checking the Lackey Moth. Of birds the only one that seems to feed upon the caterpillars is the Cuckoo, which is well known to feed on hairy larvae.

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- (1) Carpenter, G. H. Injurious Insects, etc., observed in Ireland during the year 1906. Eeo. Proc. Royal Dublin Society, I., pt. 11, p. 438 (1907).
- (2) Kollar, Vincent. 'A Treatise on Insects,' p. 200 (1840).
- (3) Theobald, F. V. Report on Economic Zoology for the year ending April 1st, 1907, p. 25 (1907).

THE DECEMBER MOTH.

(*Poecilocampa populi*. Linn.)

The natural food plants of this insect in its caterpillar stage are poplar, lime, oak, elm, birch, sallow, elder, ash, aspen and whitethorn. Carpenter (1) records it on apple in Ireland, from Newcastle, Co. Clare, where it was very injurious.

The moth takes its name from its appearing in December, but a few may often be found in the preceding month. It is a common and widely distributed insect, especially in the Midlands and the south and west of England.

LIFE-HISTORY, HABITS, ETC.

The moth measures a little over $1\frac{1}{2}$ inch in wing expanse; the fore wings are a dark purple-red, brown to rusty brown, inclining to a brighter hue at the inner corner, where it is followed by a wavy buff line and another curved line across the wing beyond the middle; the hind wings are paler and show a still paler central stripe.

In some specimens the ground colour is blackish-brown, and the brighter markings are absent. The thorax and body, as seen in the photograph, are robust and hairy.

The moths fly at night in December, and are attracted to light, being frequently found in houses and village shops.

The female apparently lays her eggs at night and they do not hatch until the following March or April (Carpenter) (1). The caterpillar is very variable; Buckler (2) figures four quite different forms after the last moult. The normal appearance is as follows: bluish-grey with a double row of grey, black-edged spots along the back, and a row of large black spots on each side, there are also dashes of



(F. Edenden.

FIG. 21.—DECEMBER MOTH
(*Poecilocampa populi*).

crimson and black on the back ; the venter is dull orange with black spots, and the body is hairy, the sides fringed below with more numerous and rather long grey hairs, with a few still longer dark brown ones. In length they reach $1\frac{3}{4}$ inch. Another well marked form described by Morris (3) is yellowish-grey with a dark grey band spotted with white on each segment, darker on the back, on each of which is an interrupted orange line and two red spots on the posterior part of the second segment.

Another form is dull brownish-grey with a black spot at the sides of each segment and with traces of dark brown spots edged with black on the dorsum, and four white spots in front and two behind.

Buckler (2) figures a beautiful variety of pale grey and dark grey hue with a black dorsal line swelling out on each segment and bearing on each swollen area a pair of yellow spots ; the hairs brown.

They mature by June and then pupate in a slaty-grey cocoon amongst leaves, etc., at the foot of the trees, or even in the soil. The pupa is reddish-brown.

TREATMENT.

Should this caterpillar occur, as it has in Ireland, in such numbers as to do harm, it may easily be checked by spraying with arsenate of lead.

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THE FIGURE-OF-8 MOTH.

(*Diloba caeruleocephala*. Linn.)

The caterpillar of this rather inconspicuous yet readily identified moth is popularly called the "Blue-head." It feeds upon apple, plum and cherry, and is also recorded as feeding upon blackthorn and sloe by Morris (1) and Stainton (2). It is frequently abundant on hawthorn hedges. In Huntingdonshire in 1887 the writer found it stripping the hedgerows at Swineshead and Great Staughton, but the following year it was quite scarce. Miss Ormerod refers to it in 1890 (3), specimens being regularly sent to her as doing mischief in the orchards.

It, however, is seldom a serious enemy of the apple. The reason

of their sudden disappearance after an abnormal number have appeared, as in 1887, is undoubtedly the fact that a heavy storm or wind knocks them off the trees, and then many are destroyed. This was pointed out by Taschenberg many years ago.



[A. V. D. Rintoul.]

FIG. 22.—FIGURE-OF-8 MOTHS.
Male and female.

various shades of greyish-brown and brown with pale ring-like spots, one on each wing, being of the form of the figure 8; in some specimens a faint rosy tinge is noticeable; the hind wings are greyish-brown with darker ray-like lines and a dark wedge-shaped patch at the hinder angle.

It is common and widely spread all over Britain, and may be found flying at dusk and when dark in orchards and gardens and along hedgerows.

The female lays her eggs singly and usually widely apart, but now and then one finds them in groups of five up to ten, and according to Ormerod (1) in groups of six or eight. They are placed anywhere on the shoots and spurs of the fruit trees and are easily seen owing to their grey or greyish-brown hue; they are round in form, flattened below and with radiating ribs. As described by Buckler (2), they are curiously covered with brown



[F. Edenden.]

FIG. 23.—EGGS OF FIGURE-OF-8 MOTH.
(*Ditoba curvuleocephala*).
(Greatly enlarged.)

hairs. These are placed in an irregular manner, and soon get washed off by rain. The hairs, as seen in the photograph, are dark and are not found on all the eggs (Fig. 23).

The ova hatch about the time the leaves are beginning to expand. The larvæ at once feed upon them, usually taking their food singly, even if the eggs are laid close together.

The caterpillar (Fig. 25) is very marked, owing to its head being blue with two small black spots; the body is of varied hue; some are yellowish-green, others bluish-grey and more yellowish-green below, with a broken yellow line along the back and another on each side below the air holes, and the segments have small black spots; the pale legs are also spotted with black, as also are the sucker-feet. When full fed the caterpillars are plump and very sluggish and reach over 1 inch in length.

[F. Edenden.
FIG. 24.—FIGURE-OF-8 MOTH AT REST.



[A. V. D. Rintoul.
FIG. 25.—LARVÆ OF THE FIGURE-OF-8 MOTH.

Immature forms on foliage.

entirely covered with it. From these in September and onwards into November.

They devour the foliage with rapidity when about half grown, and continue to do so until a few days before they are full fed. They are mostly mature by the end of June; some sent me from Yorkshire were just ready to spin by the first week in June in 1900, others have been observed as late as the 7th of July (1905), a record in an old notebook records one spinning on the 3rd of July (1884). Many of the caterpillars leave the trees when full fed and spin a rough grey cocoon on any convenient spot, others do so on the twigs and boughs of the trees. With the silk are mingled bits of bark, and they may be even cocoons the moths hatch out

PREVENTION AND TREATMENT.

As this moth comes to light it may possibly be prevented from causing any annoyance by using light-traps, such as Vermorel's "Medusa Lamp" (*vide App. D.*). Mr. Wise reported to Miss Ormerod that in November they were catching this moth by means of lamps in the Toddington plantations. The arrangement employed there was simply placing a lighted lamp in an open shed, which had the underneath parts of the roof tarred or greased. The Medusa lamp mentioned, however, is far more convenient and will attract many night-flying moths and so prevent egg-laying.

When numerous enough to need treatment, the arsenate of lead wash is all that is necessary.

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THE VAPOURER MOTH.

(Orgyia antiqua. Linn.)

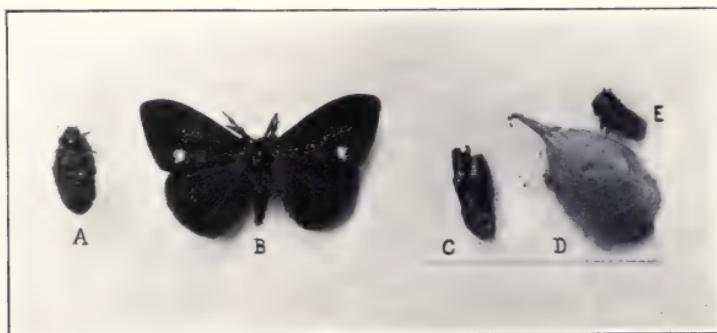
The Vapourer Moth is one of those insects which delights as much in a town life as in a country one. It is no unusual thing to see the male of this moth flying in the crowded thoroughfares of London and the suburbs and in other large towns.

They sometimes appear in large numbers and cause much damage, in their beautiful caterpillar stage, to fruit and forest trees and even roses.

Amongst the favourite food plants may be mentioned the apple, pear, plum, damson, roses, hawthorn, sloe, and even the fir. Buckler (5) records the *Acacia dealbata* also as a food plant. In some years it has been found on elm and lime, and I have found it on the walnut.

Some seasons it appears in large numbers in the London parks, and records have been sent of the great damage caused by it in the north of England to hawthorn hedges. Carpenter (6) records it on apple from County Leitrim on trees imported from France.

The female is quite wingless, but the moth belongs to quite a distinct family from the Geometridæ or Loopers. Réaumur (1) gave an excellent description of this insect. It is widespread over Europe.



[F. Edenden.]

A, female; B, male; C, empty pupa skin; D, cocoon; E, larval skin.

Taschenberg (2) refers to its damage in Germany. Ormerod (3) mentions that its attack is known in orchard-houses as well as out of doors. The caterpillars devour the foliage, and being very ravenous, if present in large numbers, do a very great amount of harm.

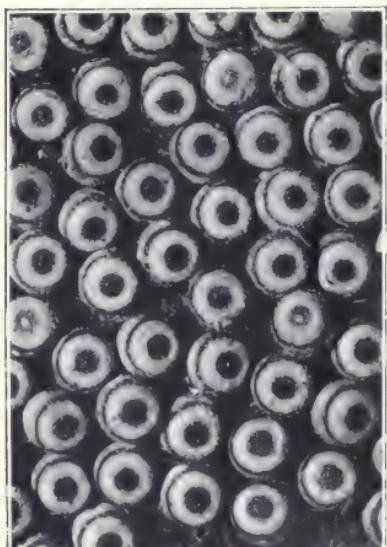
LIFE-HISTORY AND HABITS.

The male (Fig. 26 b) has four ample wings, which expand from 1 inch to $1\frac{1}{4}$ inch; the colour is rich chestnut-brown with a white spot on each fore wing, on the inner border; there are also darker transverse lines across the fore wings, and the antennæ are plumose. The female (Fig. 26 a) is grey, paler below, very plump, and practically wingless, the organs of flight being reduced, like the Winter Moth, to mere blunt processes. The adults occur from early July to the end of September; the majority in August in the south of England. The male flies by day, especially on bright sunny days, and with a rapid flight. The female is sedentary, remaining on the cocoon from which she emerged. After being fertilised by the male she lays her eggs in a close single-layered mass on the outside of the cocoon and dies. These ova (shown



[F. E.
FIG. 27.
OVA OF VAPOURER MOTH.
(Natural size.)

at Figs. 27 and 28) remain on the cocoons all the winter. In form the eggs are round, with a rim near the top where there is a central depression. Their colour varies from reddish-brown to reddish-grey.



[E. Tonge.]

FIG. 28.—EGGS OF VAPOURER MOTH.
($\times 10$.)

two a day, sometimes three, until the 29th of May when there were "twenty-one hatched and I cast adrift the remaining eggs."

The caterpillars reach about $1\frac{1}{2}$ inch when mature; they are dark greyish, spotted with red, with four large dense tufts of creamy yellow, almost white or brownish hairs on the back, like four brushes, and with a long tuft of dark hairs pointing forwards on each side of the head, another pair on the fifth segment, and a single group on the tail end, these hairs all ending in fine pin-like heads.

They are full grown from August to September; although many usually occur together they feed separately on the leaves. When full fed they spin cocoons of pale silk mixed with hairs from their tufts and change to brown pupæ with numerous pale hairs. This stage lasts from two to three weeks.

These cocoons (Fig. 26 d) are found on the twigs, stems, etc., of the trees, on fences, etc., near by, and are quite conspicuous objects when covered with the ova (Fig. 27).

They may commence to hatch out as early as the end of April, but such is unusual; more usually they hatch in June, and each batch of eggs hatches out irregularly. According to Newman (4), they come out a few at a time over a period of ten weeks.

Buckler (5) mentions that some eggs began hatching on the 14th of May, and the larvæ continued to hatch out about



[F. E.]

FIG. 29.—CATERPILLAR OF VAPOURER MOTH.

PREVENTION AND REMEDIES.

The egg-masses on the cocoons, which are very noticeable in winter, should be collected and destroyed; where they occur in very large numbers they may be burnt off the trees with a paraffin torch to save time. Systematic collection of the egg-masses should always take place after an attack. The caterpillars are easily destroyed by spraying with arsenate of lead. Weak emulsions have also some effect on them.

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THE GREY TRIDENT MOTH.

(*Aeronycta psi*. Linn.)

This insect was received with a note that it was found attacking apple and plum foliage in a garden at Liverpool in August and September in 1906.

It does not appear to have been recorded as feeding on fruit trees before. But in 1907 several inquiries regarding it were received from various parts of Britain.

Stainton ('Manual Brit. Butts. and Moths,' Vol. I., p. 180, 1857) says of the larvæ: "on various plants." The same is also given by Wood in his 'British Moths' (Vol. II., p. 71, 1872).

The moth measures $1\frac{1}{2}$ inch across the expanded wings; the fore wings are pale grey, varied with darker marks, including one long black line from nearly the middle to the base of the wings, with several short branches arising from it; amongst the other marks is one something like an X, about the middle, just below the costa, and one shaped like the Greek ψ at the anal angle. This moth exactly resembles the common Trident (*Aeronycta tridens*), but is slightly larger.

It is also known as the Common Dagger Moth. It is found resting on tree trunks in and around woods, gardens and lanes

during the day. They are also found settled on stone walls in the north of England. It is widely distributed in Britain, and in some districts is very common.

The adult occurs in May, June, July and August, and lays her eggs on all manner of plants, shrubs and trees. The caterpillar which is found in August, September and October is dull, greyish-



[A. V. D. Rintoul.]

FIG. 30.—GREY TRIDENT MOTH (*Acronycta psi*).

black, with a broad, pale yellow line along the back, a large black prominence on the fifth segment, and a short black one on the twelfth.

The pupa is found in a dirty grey to brown cocoon, spun in crevices of the trees, or amongst moss on the ground, or on old trees.

It is not surprising to have them recorded from apple and plum or any other fruit trees, as it is well known the larvae are polyphagous.

TREATMENT.

Arsenical washing will kill them where they occur in sufficient numbers to be dealt with.

THE GOAT MOTH.

(*Cossus ligniperda*. Fab.)

The Goat Moth is one of the largest of British moths, and although really very common is seldom seen in its mature state.

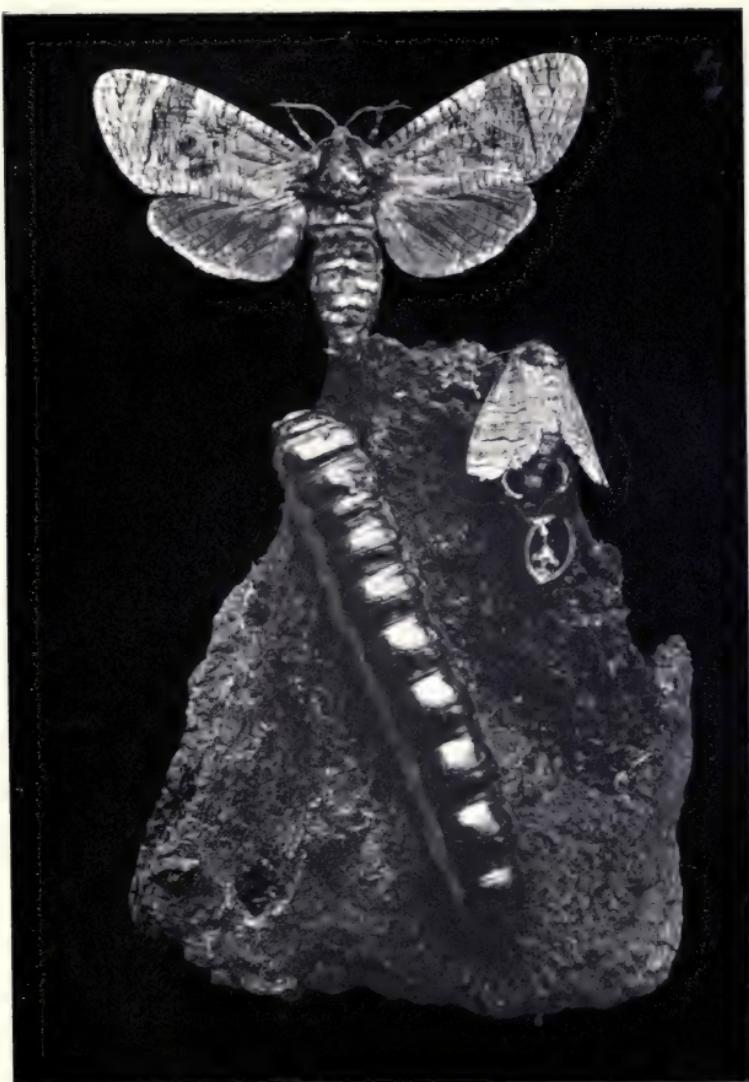


FIG. 31.

THE GOAT MOTH (*Cossus ligniperda*) AND LARVA; ALSO MOTH ESCAPING
FROM PUPA.

(To face p. 42.

This is because the dull colours of the moth resemble so closely the bark of the trees upon which they rest. Although the moth is not frequently seen, nevertheless in its caterpillar state it is a common and well-known object; whilst the damage the larvae do is so very marked that there are few people who cannot recognise the ravages of this pest.

The Goat Moth (*Cossus ligniperda*) is found in most wooded parts of Great Britain, and is especially common in and around towns, where ornamental and park trees are frequently ruined by them. I have seen great numbers of trees killed in and around London, whilst in the suburbs the damage is still more frequent.

Similarly in France, especially around Paris, considerable damage is done by them; the elms in the Bois de Boulogne have suffered severely. It is also a pest in Germany and other parts of Europe. In Great Britain it is perhaps most abundant in the south and east, but its attacks are frequent even up to the extreme north of Scotland.

The damage is done to the trees by the caterpillars eating tunnels and galleries into the very heart of the trunks. They do not pick out unhealthy trees only, perfectly sound ones often being invaded. As a rule, when once a tree is "struck," unless remedial measures are employed, it will be killed sooner or later, according to the number of these pests attacking it.

Not infrequently reports are sent from orchardists as to their damaging apple and pear trees, and I have seen them once attacking the walnut (1). The damage done in orchards is, however, unusual. It has been recorded as attacking apple and pear in France, and in Germany Taschenberg (2) records that two hundred and sixty-six larvae were taken from one pear tree. The number found in a tree varies from one or more up to the number recorded above by Taschenberg. Generally, not more than twenty or thirty are found in a forest tree of the largest size in this country, and but few, as a rule, in fruit trees. The wood eventually becomes completely honey-combed, and it is not until the tree is really dead that they stop their work. The caterpillars, if not mature, leave the dead tree and crawl to a neighbouring one, or may even feed on roots in the ground.

Their presence can be told, when in small numbers, by the holes in the trunk, often as big round as a man's finger; later, boughs begin to die and break off during gales, even when they are still sufficiently healthy to have foliage upon them. In a few years the damage becomes more noticeable, both in regards to decaying and

dead boughs, and especially in the trunk, which becomes perforated with innumerable holes up to about eight feet from the ground.

They cause the death of a tree much more rapidly than is generally supposed. An ash which I kept under observation (3) was first attacked in 1891; the tree was left alone, and for eight years struggled on, not only not growing but gradually decaying, until it put out a few stunted leaves as a dying effort, and by 1903 it was quite dead. This tree was thirty-six feet high and four feet in circumference six feet from the ground. It is only old apple and pear trees that are attacked, especially old cider and perry fruits.

LIFE-HISTORY AND HABITS.

The Goat Moth (Figs. 31 and 32) varies to some extent in size, the female being from 3 to $3\frac{1}{2}$ inches in expanse of wings, the male

from $2\frac{3}{4}$ to 3. In build it is stout and clumsy; the head clothed with dense grey hairs; the thorax greyish-brown; the large, hairy abdomen has darker transverse bands, and the apical borders of the segments are grey; the broad fore wings dark grey and brown, with dusky transverse streaks; the hind wings ashy-grey to greyish-brown, with some indistinct brown marks, and the antennæ are fringed with grey in both sexes. It occurs during June and July, and flies at dusk, but



[A. V. D. Rintoul.
FIG. 32.—FEMALE AND MALE GOAT MOTH (*Cossus ligniperda*).
(Slightly reduced.)

is very inactive, usually depositing its eggs on the trees from which they hatch. The female has a horny extensile ovipositor, by means of which she places her eggs far in crevices, etc., of the bark of the trees. It is said that one female may lay as many as a thousand eggs (Kollar (4)). Three females kept under observation each deposited between two and three hundred. They were laid in

groups varying from fifteen to fifty. The eggs are laid mainly at night and are brown in colour, round, convex above, flattened below and ribbed. In ten days the larvae hatch out and at once burrow under the bark and soon into the wood. The young caterpillar is pink all over, but when mature is dirty, deep ochre-yellow with a broad stripe of rich mahogany-red down the back; the head is deep blackish-brown, and there are two deep brown spots on the first segment; the legs are brown, and the forelegs yellow with brown hooks. When full grown the larvae reach from 3 to $3\frac{1}{2}$ inches in length (Fig. 31). They feed on the trees for three years, tunnelling into the wood most of that time. Now and then they leave the trees and wander about; some never return. Numbers of cases have been reported of these larvae being found in the earth devouring and burrowing into the roots of plants, such as dahlias (3). Normally, in the spring of the third year the larva comes to the entrance of the tunnel and close to it forms a cocoon lined with silk and coated outside with wood chips. Pupation takes place as a rule in May. The pupa is rich brown with rings of sharp spines on the abdominal segments. The moth emerges in three or four weeks after pupation. Previous to the emergence the pupa forces its way out of the cocoon and partly out of the opening in the tree; the empty pupa skins may frequently be seen in that position. When kept under unnatural conditions the caterpillars have taken four years to mature.

PREVENTION AND REMEDIES.

Trees in close proximity to others that are attacked may be protected by thickly smearing the trunks over in May with a mixture of clay, lime and soft soap. This should be made into a thick paint and smeared all over the trunk up to eight feet and a thick layer put around the base and the ground. Clay and cow-dung has been found to answer the purpose, but is not nearly as good as the former mixture. This will prevent the eggs being deposited on the trunk and roots where exposed. It is quite useless to scrub the bark, as suggested by Miss Ormerod, for the eggs are laid deep in crevices and would not be reached in the majority of cases, neither can many be rubbed off, as suggested. For killing the larvae in the trees, the best plan is to place lumps of stick cyanide in each hole and smear the whole trunk over with clay, the entrances to the holes being firmly plugged up with the same.

Paraffin emulsion squirted into the holes is said to be a good remedy, but where the tunnels are very long and tortuous it is very doubtful if many are killed by it. Sulphur and tobacco fumes blown

in by means of bee bellows have also produced good results, but no plan is as successful as the cyanide treatment and stopping up the holes with clay.

A correspondent writes that he has saved some valuable trees by injecting about 2 c.c. of carbon bisulphide into the tunnel and closing the hole with wet clay. This almost invariably killed the caterpillars.

All dead trees should be burnt at once when possible before the caterpillars escape.

NATURAL ENEMIES.

Bats, Goat-suckers, and Owls eat the moths. The Green and the Large Spotted Woodpeckers devour the caterpillars and pupæ. The Tits or *Paridæ* devour the eggs, according to Taschenberg (1). Probably the Tree Creeper, Wryneck, and Nuthatch do the same. The pupæ are sometimes infested with Ichneumon fly larvæ.

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- (3) *Theobald, F. V.* Second Report on Economic Zoology (Brit. Mus. N.H.), pp. 77-84 (1904).
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- (5) *Ormerod, E. A.* 'Handbook of Insects Injurious to Orchard and Bush Fruits,' p. 18 (1898).

THE WOOD LEOPARD MOTH.

(*Zeuzera pyrina*. Linn.)

This large moth has long been known as a borer into the trunks of various trees in this country and all over Europe. It is generally supposed to be partial to the chestnut, hence its old name, *asculi*. Kollar (1) says in reference to this as follows: "Choosing that tree (chestnut) for its abode less frequently in the neighbourhood of Vienna than any of the other trees that serve it for food, living chiefly in elms, walnut, pear and apple trees." It is certainly often found in the chestnut in our country, but is not noticed to the same extent that it is in fruit plantations. Like many noxious insects it has spread abroad, and we learn of its occurrence in the United States, attacking and destroying elms and maples (2).

Its chief damage is to the small branches of the cherry, but it

has been sent me from apple and plum both from the south and Midlands of England. Whitehead (6) says that pear trees are its special favourites, and he also records as many as seventy-six larvae being taken from one tree in Herefordshire in 1879.

In 1884 several were found by me in a young walnut tree, the tree having been killed by their tunnelling into it near the ground, and other instances of their destructive habits in the walnut have also been brought to my notice (3).

It has been decidedly on the increase in apple trees this last few years, hence is included in this section.

LIFE-HISTORY AND HABITS.

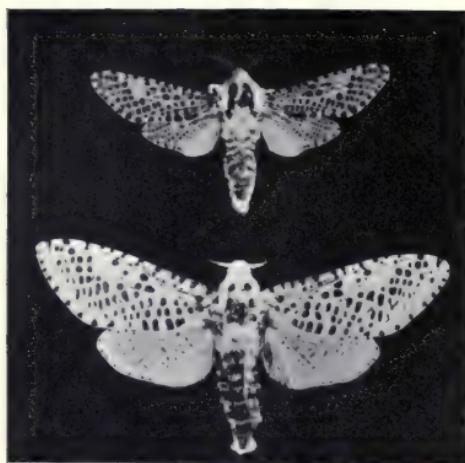
During June and July we find that this lepidopteron, which belongs to the Coccidae, makes its advent in the winged or perfect state, when they may be seen at rest upon tree trunks near the ground. The perfect insect is about 2 inches in expanse of wings; white, sometimes almost transparent white, with isolated spots of steel-blue colour, the nervures terminating in patches of the same colour. The head covered with white downy hair; antennae black. Thorax white, with two rows of three metallic-blue spots; abdomen deep bluish-black, covered at the edges of the segments with a white hairy down. The female is similar to the male, only larger,

and armed with an extensile ovipositor. The eggs, which are dark yellow or orange-yellow, are laid deep in the bark of the tree during June, July and August; they take from two to three weeks to develop. Whitehead (6) says they hatch in a few days after oviposition.



FIG. 33.

WOOD LEOPARD MOTH AND TUNNELLING-WOOD.
(One-third natural-size.)



[A. V. D. Rintoul.

FIG. 34.

MALE AND FEMALE WOOD LEOPARD MOTH (*Zeuzera pyrina*).

[F. E. #]

FIG. 35.—LARVA OF WOOD LEOPARD MOTH IN APPLE BRANCH.



[F. E.

FIG. 36.—EXTERNAL SIGNS OF WOOD LEOPARD MOTH ATTACK.

The larva is yellowish-white; on each segment are small black processes, from each of which springs a short black bristle. The head is brown, with two black spots, and is retracted into the first segment, which is shining black and broad. The larvae work right into the wood, and eat away the hardest parts, forming tunnels of some length. When full grown, which is in about ten months after their advent from the egg, they reach as much as 2 inches in length, but shorten very much prior to casting their skin for the pupal change. Each larva spins a silken cocoon, mixed with particles of wood, beneath the bark, in which it changes to a bright brown pupa.

REMEDIES.

When only a few of the larvae are present, it is possible to get rid of them by suffocating them by various vapours. An ordinary pair of "bee bellows" filled with touchwood and sulphur alight will blow or force the fumes into the hole. The fumes ascend and reach the larvae even if they are some distance up the trunk. Bisulphide of carbon fumes I found also successful in destroying the caterpillars. In all cases it is most essential to plug up the entrance hole with wax or wood so as to stop further insect attack and wet from entering, which soon leads to the rapid decay of the tree. But frequently we are unable to detect any hole; all that is seen is that the branch of the cherry, pear, plum or apple tree is dying. It is then best to cut the branch right back until sound wood is reached, and slit up the branch until the larva is found, and then kill it to prevent further damage.

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THE WINTER MOTH.*(Chionatobia brumata. Linn.)*

Of all fruit-tree pests this is one of the most harmful and widespread, but fortunately, owing to its habits, we can not only keep down its numbers, but can even exterminate it in our orchards by well-tried methods. It is needless to caution growers to take with care any such statements, as have been made, that washes will kill the eggs of this moth.

The Winter Moth takes its name from the fact that it appears late in the year. It is also called the Evesham Moth, on account of its having been noticed in numbers in that neighbourhood, but it occurs no more so there than in any other part of Britain.

The food plants are very varied; most forest trees except conifers are attacked, oaks often being defoliated by them. Of fruit, it is found most on apple and plum, but it occurs also on pear, peach, currants and gooseberries, and now and again on raspberries, walnut, roses and other flowers. The caterpillars are known as "Loopers" or "Measurers," on account of their means of progress, which is by a series of loops; the larva figured on page 53 is in an intermediate position. The family which contains this pest is known as the *Geometridæ*.

So great in numbers do these "Loopers" become that they often quite defoliate the trees (Fig. 44), and later are known to attack the fruit, eating holes in the sides (Figs. 39 and 40). When young they also damage the blossoms and even buds.

One of the worst attacks was in 1868 and 1869 in the apple and pear orchards of Herefordshire and Worcestershire. In 1907 an enormous amount of harm was done in parts of Kent and in a few cases in Worcestershire. In the Sittingbourne and Faversham areas in the former county the trees looked in summer as if it were winter. Mr. Gardener of Ombersley complained loudly of the harm they were doing to his plums, and found they were spreading below on to the gooseberries. This habit has been recorded by Ormerod (2) from Kidderminster and also from Gloucestershire, where they passed on to currants beneath the plums. So widespread is the attack of this pest that it is not necessary to refer to any further specific cases. Carpenter (1) records the attack of this insect in Ireland in County Fermanagh.

Fortunately, what we already know of its life-history goes a long

way to place this enemy under our control. The only unfortunate thing is that the Winter Moth also feeds upon various hedgerow and forest trees, and thus we are always liable to invasion if our plantations and gardens are approximated to woods, spinneys, and ill-kept hedgerows. Nevertheless, owing to the peculiar structural characters of the female, the damage from this source is much lessened.

LIFE-HISTORY AND HABITS.

The male Winter Moth is a fully-winged insect, although its flight is not powerful. In size it is about $1\frac{1}{4}$ inch from tip to tip of the expanded wings. There is not much variation in size in the males, but in the female this is the reverse, as is seen in the accompanying photograph (Fig. 37).

The colour of the fore wings varies between greyish-brown and brown; some few may show an ochreous tinge, marked with several transverse darker wavy lines varying in distinctness in different specimens; the hind wings are of a paler uniform colour.

The female is greyish to greyish-brown in colour, and differs totally from the male, having the merest traces of wings, which are totally useless as organs of flight; these remnants of wings sometimes show ornate-ments, the fore pair having two darker transverse streaks, the hind pair rarely a trace of a single one.

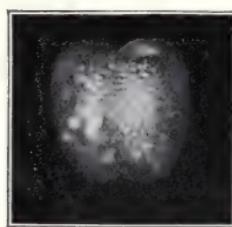
There is some variation in size of these wing remnants, but none have been seen larger than those represented in the photograph. Miss Ormerod, however, gives a figure of them (2, p. 157) about two-thirds the length of the body, which must be very unusual, judging from the thousands examined.

The males have been observed for many years to appear some days before the females. They may be seen at dusk, flying lazily



[F. Edenden.]

FIG. 37.—FEMALES AND MALES OF THE WINTER MOTH (*Cheimatobia brumata*).



[F. E.]

FIG. 38.—TWO OVA OF THE WINTER MOTH.
(Greatly enlarged.)

along hedgerows and in the orchards and gardens. They are attracted by light. One often sees them collected on street lamps, and they occur outside windows.



(F. E.
FIG. 39.—APPLE
FRUITLET EATEN
BY WINTER MOTH.

This is a habit we may well bear in mind, for it is possible that we might trap them in very large numbers by light, and thus prevent the fertilisation of the females. The females crawl out of the soil from their cocoons and earthen cases. Nature directs them by one of her marvellous ways to the tree trunk, and this they ascend to deposit their eggs. Some, however, have been found in grass orchards crawling up the herbage, and it appears beyond doubt that some of these are carried by the males *in copulâ*. The number, however, is comparatively few.

The dates of appearance of the Winter Moth vary to such an extent that one can only give here very wide limits. The earliest date I have record of is the 1st of October, 1896, and the latest the 12th of January, 1905. This was on walnuts at Kingston-on-Thames.

Their appearance on this tree is always later than on apple or plum. In some places they appear at one time, in others at another. For instance, during 1907 they were reported by Mr. Mercer of Rodmersham as covering the grease bands in November, whilst at Wye they were at the "swarming period" on the 17th of December. Six years ago the swarming period at the latter place was the 2nd of November. It is quite impossible to say when they will hatch out. The limits, for practical purposes, may be included between the 1st of October and the 15th of January. Frequently we have a few females straggling up some weeks before and some weeks after the main hatching. This again we must bear in mind, for a single female may deposit as many as 350 ova, enough, if they all hatched out, to defoliate a tree.

The females mainly seem to be fertilised during their ascent, but have been found *in copulâ* on the shoots. Whether the latter had been carried up by the male or not is unknown.



FIG. 40.—CHERRIES EATEN BY WINTER MOTH LAR.V.

The ova (Fig. 38) are very marked. At first they are pale yellowish-green, later they become brick-dust red. They are slightly elongate, truncated at each end and have a distinctly sculptured shell. The position in which they are laid varies, some are placed around buds, some are around the inside of pruned surfaces, others in crevices in the twigs and smaller boughs. Frequently they are well protected by the natural hairs of the shoots, mosses, lichens, etc. The shell is thick and is quite unlikely to be affected by any chemical that would not seriously harm the trees, if not kill them. The period of hatching varies each year and in different localities. The small caterpillars usually hatch before the buds burst and at once commence to attack the young foliage as it opens. The minute "Loopers" are at first dark in colour and very difficult to detect unless they are moving. At first they feed freely on the small leaves. As they grow they become green with pale lines along their bodies, some yellowish - green, others dark green with the pale lines more prominent. The colour of the head also varies at different stages. When mature they reach $1\frac{1}{4}$ inch to rather more in length, when fully expanded. The exact length must not be taken into account however, as they vary so much according to their degree of extension. They are always much fatter than those of the March Moth, which is the only one they are likely to be confused with.



[Edenden.]

FIG. 41.—LOOPER CATERPILLAR OF WINTER MOTH.



[A. V. D. Rintoul.]

APPLE LEAF EATEN BY TWO YOUNG WINTER MOTH LARVÆ.
(Seen on the leaf.)

extension. They are always much fatter than those of the March Moth, which is the only one they are likely to be confused with.

The habits of the Winter Moth larvae are varied. At first, as explained, they feed on the opening leaf buds; later they get into the blossom trusses and spin them together and also the leaves, living under the shelter they form. Before reaching maturity they feed freely on the foliage again, and are known to attack the fruit, especially cherries. Damage to fruit has been very noticeable when they invade gooseberries growing under apples or plums.



[F. Edwden.]

FIG. 43.—PUPE AND COCOONS OF THE WINTER MOTH.

observed them do otherwise. They all reach the ground in some way, and the majority enter the soil to the depth of two or three inches. Having pressed out a small cavity in the earth they spin an oval case of silk, which becomes covered externally with particles of earth. In this silken and earthen case the "Looper" larva, having

By the middle of June the caterpillars are mostly mature and they then fall to the ground; at least we suppose so, for no one seems to have



[W. H. Hammond.]

FIG. 44.—APPLE TREES DEFOLIATED BY WINTER MOTH LARVE.

contracted considerably, casts its skin and becomes a brown pupa. This hatches into the male or female from October to early January, and the adult forces its way out of the soil. If in grass orchards it

is not unusual to find the cocoon (devoid, of course, of any earth) amongst grass and other herbage. The depth at which pupation takes place in the soil is very variable. If the soil is rough and cloddy they frequently pupate under a clod; if firm and compact they enter the soil to a depth of two inches. All those kept in confinement pupated from one to three inches, never deeper, and very few more than two inches below the surface.

PREVENTION AND REMEDIES.

The prevention of this and the allied pests, the Mottled Umber Moth and the March Moth, is an easy matter. The process, namely, grease-banding, is well known to all fruit-growers and is firmly believed in and carried out by very many.

It must be borne in mind, however, that it is only these wingless females which are caught; grease-banding has no effect on such pests as the Lackey Moth, Figure-of-8 Moth, Gold and Brown Tail Moths, Tortrix Moths or the Little Ermine, which have winged females. But where the Winter Moth and its allies are the culprits then grease-banding is far better than relying on spraying.

The bands should be made as follows:—First tie on the tree a band of good stout grease-proof paper, so that nothing can crawl beneath it, then smear this over with sticky grease. There are several kinds on the market, and the grower will find out which have the most permanent sticky qualities.

The position of the bands adopted by growers varies. Some apply them high up the trunks, others low down. In the former case the reason given is that stock rubs off the grease. It may be pointed out that when the bands are placed high up, many eggs have been detected laid on the trunks. In due course these will hatch out and the larvæ may ascend to the boughs. It is best, therefore, to apply the bands low down, about 1 foot from the surface, in grass orchards, where mud spattering does not interfere with the grease. In bush plantations this can be done, and it has been found that when placed so low down in grass orchards that sheep do little harm to the grease. Where the ground is cultivated, however, it is sometimes found that if the bands are placed lower than 2 feet that they get covered in mud.

In young trees it is necessary to band the stakes as well, for the females will crawl up these as readily as the stem.

For the Winter Moth the banding should be in working order by the 1st of October and should be kept going until the second week in January. It is of no use to grease the bands once and then leave

them. During the past year the writer visited a plantation in December in which the bands were all dry, a few days later the females were appearing in numbers, and thus, for saving a small additional expense, all that had been spent in banding the trees was wasted. Moreover, the bands frequently become so smothered with insects that others can readily pass over their dead bodies. It is not



[F. Edenden.

FIG. 45.—A GREASE-BANDED APPLE TREE.

(The band here is placed far too high.)

only female Winter Moths that are caught, but the winged males in large numbers and these aid very materially in covering the bands. Numbers of the Winter Gnats (*Trichocera regelationis*) also get caught and many midges and other flies, all tending to smother the grease and so make a bridge for later hatched moths to cross. These covered bands should be cleared and smeared again.

The numbers of females caught on each band is frequently very

large. Mr. Clive Murdock writes from Linton that many of the bands contain one hundred females; Mr. Mercer of Rodmersham that some three hundred were found on one band. Still greater

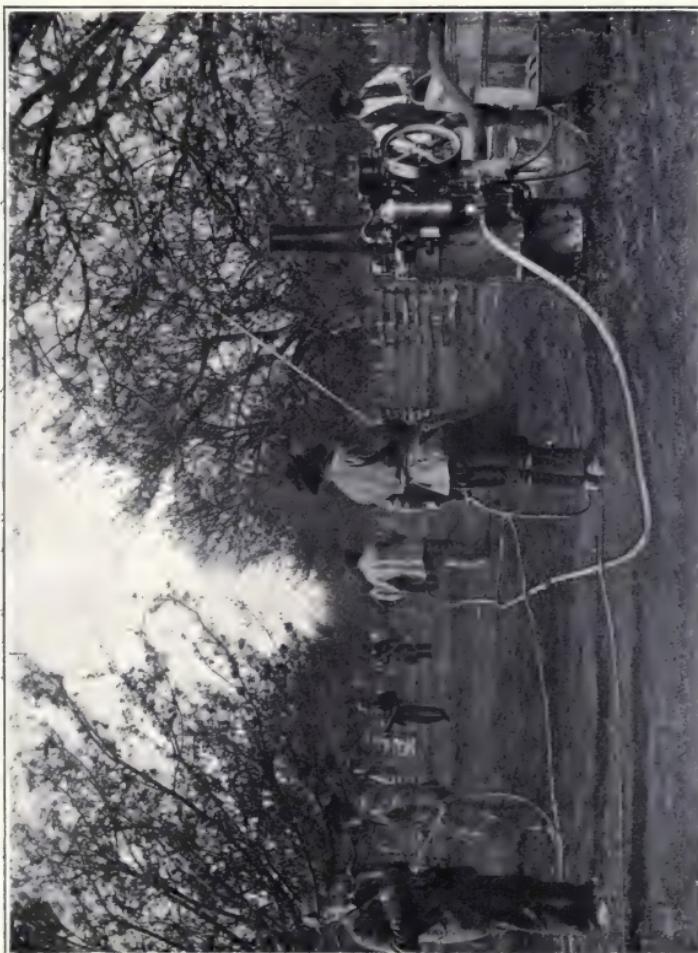


FIG. 46.

STEAM SPRAYING APPARATUS (MERRYWEATHER'S) FOR LARGE ORCHARD USE.

numbers have been found by the writer on bands sent him from various parts of the country.

Mr. Ballard, manager of the Eardiston Farming Company, near Tenbury, who follows this banding year by year, places a layer of cement around the large cider trees to receive the grease. This plan seems to work very well and does not seem to harm old, rough and

large trees, where ordinary banding would be very troublesome. In the Evesham district of Worcestershire the practice seems to be to smear the grease directly on the tree. This plan is most injurious and very slovenly. Trees so treated were noticed to have the bark unhealthy.

Spraying for Winter Moth is often necessary where banding has been badly carried out or where it has not been practised. For these caterpillars Paris green was once largely used, but owing to its frequently scorching the leaves many growers did not continue its use.

Arsenate of lead is by far the best substance to use for this pest. The two formulæ are given in the appendix, but since we can now obtain this poison made up as Swift's Arsenate of Lead Paste we had better employ this, as errors in mixing make this wash harmful, but never as bad as Paris green.

The arsenate of lead should be put on as a fine spray as soon as the leaves commence to show. The young caterpillars are then killed before they have done any damage. A second spraying is often necessary in the case of apples and pears; this should not be later than ten days after the blossom has fallen; at this time any remaining Winter Moth, Mottled Umber and March Moth larvæ are poisoned, and also the Codling Moth prevented, and many other leaf-eating forms at the same time are destroyed.

The employment of poultry in a plantation is certainly very beneficial in regards to checking Winter Moth, and some growers have found pigs of equal benefit. It is not at all unusual to see the latter in Kent orchards.

Spraying with winter washes is quite useless for preventing this pest.

REFERENCES.

- (1) Carpenter, G. H. Injurious Insects and Other Animals observed in Ireland during 1905. *Eco. Proc. Roy. Dub. Soc.* I., pt. 8, p. 329 (1906).
- (2) Ormerod, E. A. 'Handbook of Insects Injurious to Orchard and Bush Fruits,' p. 158 (1898).

THE MOTTLED UMBER MOTH.

(Hybernia defoliaria. Linn.)

The caterpillars of this moth work in a similar way to those of the Winter Moth, but they more frequently attack the fruit. Mr. W. Bear forwarded some small apples from Hailsham in 1900, which

had been gnawed by these larvæ. In 1902 specimens of similar damage were received from Yorkshire and from a gardener in Nottinghamshire.

The damage to foliage is, however, of greatest importance. Although generally distributed the Mottled Umber Moth is not nearly so harmful as the Winter Moth. Nevertheless great damage is now and then done by it to fruit trees, especially those situated near oak woods, etc. Mr. Paget - Norbury of Malvern Links has several times written complaining of this insect, which was particularly abundant on his trees near some oaks and some of which had been badly damaged, especially in 1905 and 1906. It has also been sent me with notes of its destructive habits from many places in Kent, from other parts of Worcestershire, Herefordshire, Staffordshire, Huntingdonshire, Cambridgeshire and South Devon. In the latter county Major Vigors sent it from Whimple where it was doing damage to peaches.



[E. Tonge.]

FIG. 47.—MALES AND FEMALE OF THE
MOTTLED UMBER MOTH.



[E. Tonge.]

FIG. 48.—OVA OF MOTTLED UMBER MOTH.
($\times 20.$)

The food plants are just as varied as those of the former species. Amongst orchard fruit may be mentioned besides apple, plum, cherry, pear, and cob and filbert nuts. Cherry growers in Kent have often complained of its gnawing away the fruitlets, eating out round holes down to the stone, just as the Winter Moth does. Specimens of this damage were also sent by the Fruit

Growers' Association in 1907, but no locality was mentioned. Of wall fruit, both peach and apricot are attacked occasionally; various



[F. Edenden.]

FIG. 40.—MELANIC MALE AND FEMALE MOTTLED UMBER MOTH.

forest trees, such as oak, beech, lime, elm, birch and in hedgerows, the whitethorn, blackthorn and privet. Owing to its larger size, when it appears in numbers it may do more harm than the Winter Moth.

LIFE-HISTORY AND HABITS.

The male moth varies from a little under to a little over $1\frac{3}{4}$ inch in wing expanse. The front wings are normally a pale dull yellowish, mottled with yellowish-brown and dusted with brown; there are two more or less prominent dark lines, the first bent in an angle, the second bent in three angles and often followed by a darker hue, and there is a central dark spot on each wing; the hind wings are of a more uniform yellowish-grey, with minute darker specks and a dark spot on each.



[A. V. D. Rintoul.]

FIG. 50.—LARVÆ OF MOTTLED UMBER MOTH.

The colour is, however, very variable, some specimens being dark rusty-brown all over, owing to the thick dusting of dark colour, such as is seen in Fig. 49.

The female is quite wingless and plump, much larger than the female Winter Moth, of various shades of yellowish-grey, and is much speckled with dark brown or black. Miss Ormerod (1) describes

and figures the female with two black spots on each segment, but these do not show so clearly in any females I have noticed. The moths appear from the end of October onwards until the beginning of February. The females crawl up the tree trunks, just in the same way as the Winter Moths. The ova are deposited on the buds and twigs, in bark crevices and on pruned surfaces. The caterpillars hatch out later than those of the Winter Moth, usually in April. They are readily told from the Winter Moth by their colour; the back is chestnut-brown, and the sides a pale creamy-yellow to bright yellow, the venter pale yellow to pale greenish-yellow, and the spiracles pale with dark rims. Their means of progression is just like that of the former species. When mature they reach $1\frac{1}{2}$ inch in length. They have been sent by various correspondents as late as July, but most reach maturity at the end of June, they then fall to the ground and pupate in the soil.

PREVENTION AND TREATMENT.

The remarks made concerning the Winter Moth apply here.

REFERENCE.

- (1) *Ormerod, E. A.* 'Handbook of Insects Injurious to Orchard and Bush Fruits,' p. 179 (1898).

THE MARCH MOTH.

(*Anisopteryx asicularia*. Schiff.)

This is another member of the wingless female group. Although not so generally reported as a nuisance, it now and again does considerable harm to the apple, and has also been sent by correspondents from Surrey on the plum and pear. Its normal food plants are the whitethorn and blackthorn; it also infests the oak, lime, elm, maple and walnut, and a few may be taken on the Spanish chestnut. It occurs over a wide area from Scotland downwards, and has been reported as a fruit pest from Herefordshire, Yorkshire, Sussex, Kent and Middlesex. I have also seen it in abundance on plums in



[F. Edenden.
FIG. 51.—MALE AND FEMALE MARCH MOTH.



[F. Edenden.]

FIG. 52.—FEMALE MARCH MOTH.
(*Anisopteryx ascellaria*. Schiff.)

(Greatly enlarged to show side view of tail tuft.)

woods, and along hedgerows. The colour of the fore wings is greyish-brown, with dark and pale wavy lines running across, as seen in the photograph (Fig. 51), and there is a small dark brown spot near the upper border of each wing; the wing expanse varies from $1\frac{1}{4}$ to $1\frac{1}{2}$ inch; the hind wings are pale grey, with a darker line more or less continued from the outer line on each fore wing.

The female is greyish to greyish-brown and quite wingless, and has a very pronounced fan-like tail of hairs. She crawls up the tree trunks, just as the two preceding do. The eggs are laid in a partial band, varying in size from $\frac{1}{4}$ to nearly $\frac{1}{2}$ inch across, they are deposited in more or less parallel rows and are embedded in hairs from the fan-like extension of the tail; the eggs are bright and shiny, and vary in number in each ring. Ormerod (1) records as many as five hundred in a ring, this appears to be exceptional, some fifty to two hundred being a wide limit.

The eggs hatch in April. The

Cambridgeshire and in Yorkshire. The popular name is derived from the date of its appearance. Specimens may, however, be taken as early as mid February and as late as mid April, a few stragglers going on until the end of the month.

LIFE-HISTORY AND HABITS.

The male moth flies at dusk and may be found in gardens, orchards,



[F. Edenden.]

FIG. 53.
CATERPILLAR OF THE MARCH MOTH.

small larvae soon spread about. The colour is bright green or green tinged with yellow (the latter I have particularly noticed when feeding on hawthorn) and somewhat paler between the segments; on the back is a narrow dark green line edged with pale creamy white or grey; on each side are three pale lines, either white or grey; the head is uniformly green. The general form at once separates it from the Winter Moth larva, it being very slender and uniformly cylindrical and about 1 inch long when full grown. They mature by the end of June or early in July, then fall to the ground, where they form a cocoon covered with earth very similar



FIG. 54.—EGG BAND OF MARCH MOTH.
(Twice natural size.)



[E. Tonge.]
FIG. 55.—EGG BAND OF MARCH MOTH. ($\times 10$.)

to the Winter Moth; the silk of the cocoon is of a dull yellowish hue and very closely woven together. Porritt (2) mentions that caterpillars which hatched from eggs on the 3rd of April went to earth the middle of May. Many may be found in June, and I have taken numbers as late as the 7th of July.

PREVENTION AND TREATMENT.

The treatment is the same as for the preceding. Where this moth is prevalent it is well to see that the grease bands are kept

in working order right into March, especially on plum trees and damsons.

REFERENCES.

- (1) *Ormerod, E. A.* 'Handbook of Insects Injurious to Orchard and Bush Fruits,' p. 178 (1898).
- (2) *Porritt, G. T.* 'Larvæ of British Butterflies and Moths,' vol. VII., pt. 1, p. 157 (Ray Soc.).

THE PEPPER AND SALT MOTH.

(*Amphidasys betularia*. Linn.)

Although one can scarcely look upon this insect as a pest, yet its larvæ so frequently strip the leaves of the apple and the cherry



[F. Edenden.]

FIG. 56.—FEMALE AND MALE PEPPER AND SALT MOTH
(*Amphidasys betularia*).

in the autumn that it cannot well be passed over. It is owing to its fortunate late appearance that so little harm is done, yet surely some loss of ripening of the wood must result even in late September when all the leaves are eaten off. It is much more frequent than is supposed, for two reasons: first, the grower does not much trouble about enemies when the fruit is being or has been gathered; and,

secondly, the strange mimetic habits of the larva prevent its being seen (Fig. 58).

Specimens with inquiries have been sent me from several places in Yorkshire, from most of the home counties, and twice from Somerset.

LIFE-HISTORY, ETC.

The moth (Fig. 56) belongs to the Geometridæ, the Looper-caterpillar family. In size it varies from $1\frac{1}{2}$ to nearly $2\frac{1}{4}$ inches in wing expanse. The general appearance is seen in the figure. The ground colour is dull white, and all four wings are speckled with black, variations occur such as black dots, traces of transverse black lines and a more prominent black central spot. In a few rare cases true melanic forms occur, the insect becoming almost black. They are found in late May and in June and July, in gardens, fruit plantations and woods.



[F. Edenden.

FIG. 57.—LARVA OF PEPPER AND SALT MOTH.
Green variety on rose.



[W. H. Hammond.

FIG. 58.—LARVA OF PEPPER AND SALT MOTH.
Brown variety on fruit trees.

on hop, called "Hop Cats" in Kent, are always green; in all there

are two pale, sometimes white, prominences on the ninth and twelfth segments and traces of pale lines along the body.

Later in the year the similarity to the twigs is very marked and even earlier, when the foliage is eaten, as is to be seen in the photograph shown here (Fig. 58). In 1907 I found the larvae at Wye on apple trees as late as the 2nd of November, at which date they and all preceding ones had entered the soil to pupate.

TREATMENT.

Where they occur in any numbers it is well to have them either hand-picked or the trees sprayed with arsenate of lead. As a constant feeder on apple and cherry we may expect that some day it may occur in undue numbers and call for definite treatment.

THE CLOUDED DRAB MOTH.

(*Tornioecampa incerta*. Hufn.)

The caterpillar of this moth has been reported by Mr. Getting to have attacked his apples near Ross. In his note he said: "It is astonishing what holes the caterpillar can eat in the fruit."



[F. Edenden.]

FIG. 59.—LARVA OF *Tornioecampa incerta* ON APPLE LEAF.

Later, Mr. Getting wrote me that he had only found the two actual caterpillars sent me, but that he had come across a good few suspiciously eaten apples. "The first I sent I found actually eating the apple" (2). This insect has also been sent from Kent, with a note that it was harmful to the foliage of young trees.

The normal food plants of the caterpillars of the Clouded Drab Moth (*Tornioecampa incerta*) are sloe, willow and oak. Taschenberg

records it feeding on the elm and lime (1). The moth is pale leaden grey, with three thin darker, wavy, transverse lines, and a broad dark area between the second and third thin lines; the hind wings are



[F. Edenden.]

FIG. 60.—THE CLOUDED DRAB MOTH.
(*Tenuicampa incerta*.)FIG. 61.—PUPA
OF *Tenuicampa*
incerta.

unicolorous, but the veins show up darkly; the hairy thorax is the same colour as the fore wings, and the broad hairy body is paler than the thorax. In colour, however, there is some variation, for it is not



[F. Edenden.]

APPLE AND LEAF EATEN BY CATERPILLAR OF THE DRAB MOTH (*Tenuicampa incerta*).

infrequent to find dull reddish-brown specimens. The wing expanse varies from $1\frac{1}{4}$ to $1\frac{1}{2}$ inch.

Like most of this group, it occurs freely at sallow blossom in the

spring, and may be easily collected at dusk by shaking the blossoms over an open umbrella. They occur on the wing in March and April, and a few straggle on into May.

The caterpillar is green, dotted with black, with a dorsal yellowish-green line and two lateral lines of the same colour. They may be found in May, June and just into July, and normally feed on the leaves; the habit of eating the fruit and occurring on apples appears to be abnormal. When mature they reach $1\frac{1}{4}$ inch in length, and then pupate in the soil. They are said to form a loose cocoon of particles of earth, but the one sent by Mr. Getting changed to deep rich brown pupa nakedly in the breeding cage.

The moths hatched out in February owing to their having been kept in a warm laboratory.

It is also known as *Tanycampa instabilis*. Esp.

This insect is common everywhere in Britain.

REFERENCES.

- (1) *Taschenberg, E. L.* 'Praktische Insekten-kunde.' Die Schmetterlinge. Dritter Theil, p. 137 (1880).
- (2) *Theobald, F. V.* Report on Economic Zoology for year ending April 1st, 1907, p. 25 (1907).

THE GREEN PUG MOTH.

(*Chloroclystis rectangulata*. Linn.)

Although little or nothing has been recorded concerning this insect as an enemy of the apple it is nevertheless very harmful. Carpenter (1) refers to it in Ireland, having noticed it on apple branches sent from County Fermanagh. Mr. Jeffreys of Ashford many years ago pointed out to me the importance of this insect to apple growers, but no direct observations have been made on it, although it occurs in small numbers all over the country. The damage is done by the small caterpillars feeding in the buds and blossoms of the apple and pear. They feed mainly upon the petals of the blossoms, but also gnaw the strings and even young leaves; now and then one notices some of the blossoms of the trusses spun together by this caterpillar, and the work may casually be attributed to the Winter Moth unless the culprits are carefully examined. It is also known as *Eupithecia rectangulata*.

LIFE-HISTORY AND HABITS.

The moth has a wing expanse of about $\frac{3}{4}$ inch, the fore wings are deep green with dark brown and grey bands, and the hind

wings have also a similar greenish tinge. The abdomen is of somewhat similar hue and crested, with two more or less darker spots near the back. It appears in May, June and July. The female places her eggs on the fruit trees and they remain there all the winter. In spring the larvae appear and enter the opening buds. The caterpillar is pale yellowish-green with a rusty-red line down the back, the divisions between the segments reddish and a line at the sides of a yellowish-green. The dorsal line varies in colour and size; some have it broad, others narrow or almost absent, sometimes it is dark green, at others almost purple. These larvae are most noticeable in April and May and are all mature by early June. They then fall to the ground and pupate in a cocoon of earth. The pupa is deep red at the tail end, the thorax and wing cases yellow, tinged with olive.



[F. E.]

FIG. 63.—GREEN PUG MOTH
(*Chloroclystis rectangulata*).

TREATMENT.

Early spraying arsenate of lead. The same spraying used for Winter Moth should suffice. It may be pointed out that if these caterpillars are in excess grease-banding need not be persisted in.

REFERENCE.

- (1) Carpenter, G. H. Injurious Insects and Other Animals observed in Ireland during the year 1905. Eco. Proc. Royal Dublin Society, vol. I., pt. 8, p. 331 (1908).

THE CODLING MOTH.

(*Carpocapsa pomonella*. Linn.)

Everyone knows a maggoty apple and avoids it unless they can get no other. Few people, except fruit-growers and gardeners, know anything of the cause, however. The "maggot" is the caterpillar of a small moth, one of the *Carpocapsidae*, whose larvae live in fruits or seeds. If we turn the Codling Maggot over on its back we shall see that below are legs, these are of two kinds, the first six are horny and pointed, and then in the middle of the body are four pairs which are soft and fleshy "false legs," and there is another pair behind. Thus the Codling Maggot is a true caterpillar, like that of the Cabbage White Butterfly. It is very important for growers to notice this, as

two other kinds of larvae occur in apple, one abundantly in this country, namely, the Apple Sawfly (*Hoplocampa testudinea*), and the other the Apple Fruit Fly (*Trypetia pomonella*, Walsh), which occurs in America. The former has more legs than the Codling Maggot; the latter has none.

The small Tineid Moth (*Argyresthia conjugella*, Zeller) also attacks apples in Europe (*vide Bevetning om Skadeinsekter og Plantesyglomme i Land-og Havebruget, 1905*. By W. M. Schoyen, pp. 22-23, 1906, Kristiania).

The damage the Codling Maggot causes is often very serious. Frequently the crop has been almost ruined, especially in the cider-growing districts of the western counties. Our choicest dessert apples suffer just as much as the cooking and coarser kinds.

Years ago it seems to have been well known, for in an old Dutch book published in 1645 (1) we find an account of it and also a figure. Cato wrote on "Wormy Apples" in his treatise on Agriculture, written nearly 200 years B.C. Year by year it has become better known, and year by year it has spread further and further afield, until we now get the Codling Moth in nearly all parts of the world where apples are grown.

If we go to the market and examine American, Canadian, Portuguese or Madeira apples, we find them often badly damaged, and also numbers of the live maggots in the barrels, etc., they come over in. In this way they have been spread from country to country.

The Codling Moth has several relatives, all of which live in seeds or fruit, one we find in the sweet chestnut (*Carpocapsa splendidana*), another in beech nuts (*Carpocapsa grossana*), another in euphorbia seeds, the so-called "jumping beans," the movements of the caterpillar within the seed causing the seeds to jump into the air.

The appearance of the infested apples is too well known to need description here, but is depicted in the photograph (Fig. 68).

LIFE-HISTORY AND HABITS.

The difficulty in observing insects laying their eggs is always great, and amongst those which fly at twilight and at night almost impossible, at least in their natural state. We shall have to watch



FIG. 64.—SOME OLD FIGURES OF THE CODLING MOTH.

very carefully to see the Codling Moth at this operation. The moth first appears about the time the apple blossom commences to fall, but in very small numbers. In size it is usually about $\frac{1}{2}$ inch across the expanded wings; the front wings are grey, with numerous darker wavy transverse lines and a metallic eye-like spot at the corner; the hind pair are plain grey. The male can be told from the female by the former having a distinct short dark line on the under surface of the front wings. These moths are extremely pretty creatures when seen in the light, the wings having a satiny sheen. When at rest the wings are closed up in roof-like manner over the abdomen. During daylight we find them resting under the leaves and on the trunks of the trees. When in the latter position they are very difficult to detect, especially if the trees are covered with lichens and moss, owing to the colours of the wings blending with those of the tree. This protective coloration in insects is often very marked, much more so than in the insect we are dealing with, and serves to protect them from the prying eyes of birds and other natural enemies.

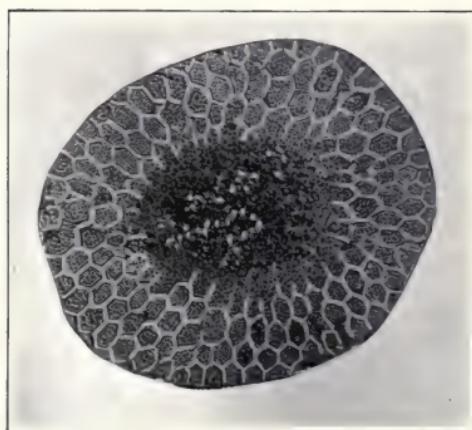


FIG. 66.

GREATLY ENLARGED OVUM OF THE CODLING MOTH.
(The actual size is smaller than a pin's head.)

parent round body, resembling a fish scale and shining on the fruit like a drop of dew. If we look at it under a microscope we see it is beautifully sculptured, especially round the edge. So

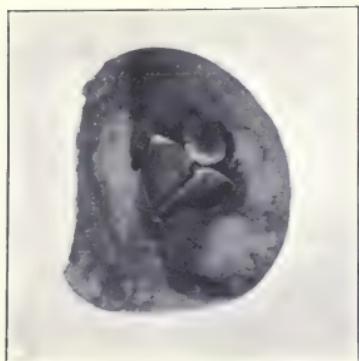


[W. H. Hammond.

FIG. 65.

CODLING MOTHS, PUPA AND COCOON UNDER BARK.

The eggs (2) are placed separately, as a rule, on the sides of the fruit, but now and again on the leaves. Each egg is a very thin, almost trans-



[F. Edenden.]

FIG. 67.—A CODLING MAGGOT IN APPLE.

first week or ten days after the apple blossom has fallen, the separate parts surrounding the eye (the calyx) remain pointing outwards, but later on close up to some extent over the eye. In either case the small larva can easily enter. At first it feeds upon the tissue of the eye and then commences its passage deep into the pulp of the fruit. Its first objective seems to be the core, and during its tunnelling operations it forces its excrement (called "frass") out of the small hole of entry at the eye. Thus we can detect a struck apple in its early stages by the wet brown matter oozing from the top. Later on the culprit forms a further tunnel to the exterior, opening as a large round hole at the side, bottom or even summit of the fruit. From this opening

transparent is it that we can observe the little caterpillar being formed inside.*

Only one egg as a rule is placed on each apple, and as a single female may lay over one hundred eggs we see what great harm a small number of these little moths may do in a garden or orchard.

As soon as the little caterpillar escapes out of its egg-shell it crawls over the apple, and when it comes to the "eye" it has reached the first stage of its journey. During the



[W. H. Hammond.]

FIG. 68.—APPLES ATTACKED BY CODLING MAGGOT.

(Slightly reduced.)

* The first full account of the egg was given by Slingerland. Bull. 142. Cornell University Agricultural Experiment Station, U.S.A., fig. 131, Jan. 1898.

more wet frass is ejected, as long as the maggot remains within the fruit. Some little while after this opening has been formed, the mature stage of the larva is reached. The caterpillar is then about $\frac{1}{2}$ inch long, pale pinkish in colour, with a few scattered hairs and brown head.

Sometimes the larvæ are creamy white, at others a deep pink. This latter colour I have particularly noticed in those coming from abroad.

The time has now come for leaving the fruit. This they do in two ways: the majority lower themselves to the ground, if the fruit has not fallen, others crawl out of the apple and down the branches. Those that fall to the ground reascend the tree trunks, and make their way under the first shelter they come to. If it is in an old orchard they crawl under the rough bark, or the moss and lichens growing upon the trees; if it is a young orchard, or one kept very clean, they get under such protection as the sacking used to prevent the string, by which the young trees are held to stakes, from cutting the bark, or between the forks of the branches.

In these sheltered spots the larvæ spin rough cocoons, often mingled with wood chips when formed under the bark. The silken cocoons are sometimes dusky white, sometimes brown. In these cases the larvæ cast their skin in the spring and change to chestnut-brown pupæ, from which the moths ultimately hatch.

As a rule, we have only one generation of Codling Moth during the year, but there may be two. For a long time there has been an



[W. H. Hammond.

FIG. 69.—APPLES ATTACKED BY SCAB FUNGUS.

Often mistaken for insect damage.

(Half natural size.)

idea that now and again there is a second brood in this country. During 1906 I succeeded, under normal outdoor conditions, in hatching out moths in August, which deposited eggs on apples out of doors, the ova hatching in six days, and the maggots entered the fruit at the base, not the eye. These larvae matured by the 10th of October. Thus we have proof here of a second brood, just as happens in parts of America. During the same year Mr. Getting sent me Codling maggots from Ross, found in the last week in September in Cox's Orange Pippins. Many of these apples had been freshly attacked, and Mr. Getting noticed that the entrance hole was either at the side or base of the fruit. In warmer climates than ours there may be even more than two broods in each season.

The larvae that form their cocoons in the autumn remain in the same condition until spring, when they change to pupae a few weeks before the moths emerge. But when they spin early in the year and are going to give rise to a second generation, they pupate a few days after the cocoons are completed.

Slingerland (2) gives the life of the caterpillar as varying from twenty to thirty days. They take longer to mature with us, some under observation took fifty days. Ormerod (5) states that they take four weeks.

NATURAL ENEMIES.

It is during the winter that the numbers of this pest are reduced by natural agencies. The Tits, especially the Blue and the Great Tit, devour the larvae, wrenching them out of the cocoons after breaking off the sheltering bark beneath which they are hidden.

There are not nearly enough of these birds, however, to do sufficient good, for year by year we get orchards and gardens robbed of much of the fruit by this noxious yet interesting little insect.

Recent reports of the benefit of parasites in connection with this pest are of interest, but seem to be of no practical value.

Slingerland (2) records a number from America. The ova are attacked by a minute hymenopteron, *Trichogramma pretiosa* (?), and the larvae also suffer from Ichneumon parasites, but the Codling Moth persists in enormous numbers.

In Europe the parasite mentioned on p. 77 occurs in some numbers.

PREVENTION AND TREATMENT.

We can, however, lessen their number ourselves very easily. To accomplish this all we have to do is to tie a band of hay or old cloth around the trunk of the tree close to the ground about June. If we examine the band in the winter we shall often find it full of the cocoons of the Codling Moth. These bands can be burnt, and so very great numbers of the pest may be destroyed. Several correspondents have written stating that they have collected large numbers of the maggots during the past few years by banding the trees, and that, in consequence, the number of maggoty apples have been much reduced. Old manure sacking is very suitable for this purpose.

A few remain, having come down from above, and will hatch out and lay their eggs, these may be coped with by spraying the trees with an arsenical poison directly the blossom has fallen. The poison lodges in the eye of the apple, and the first meal the young caterpillar takes is arsenic, instead of apple, and so it is killed.

This spraying should take place not later than ten days after the blossom has been shed. At the same time the fungicide Bordeaux mixture may be used with the arsenate of lead. The latter can now be obtained in paste form (Swift's Arsenate of Lead Paste), which is more convenient to use than the home-made mixture.

This spraying must be done properly to be successful. As fine a mist as possible must be thrown out, so that it penetrates well into the calyx. A great deal depends upon the right time of application. In a mixed orchard, it is of course impossible to do this at one operation, owing to the various times of blooming. For other reasons as well, it is thus advisable to grow only one or two kinds of apples in each plantation.

Of the three arsenates used for this purpose, viz., Paris green, London purple and arsenate of lead, there is no doubt that the last-named is much the most potent. The following table (3) may here be quoted showing the benefit derived from arsenical spraying.



FIG. 70.—THE HAY-ROPE BAND IN OPERATION.

(Reduced from Dr. Trimble's picture.)

A.—IN AMERICA.

	Treatment.		Percentage of Fruit Harvested.	
I.	Paris Green, $\frac{1}{4}$ lb. to 50 gallons. water	.	61·65	[*] 63·04
	Paris Green, $\frac{1}{2}$ lb. to 50 gallons. water	.	43·46	51·33
	Arsenate of Lead (weaker solution)	.	74·98	81·63
	Arsenate of Lead (stronger solution)	.	82·50	81·45
	Unsprayed .	.	43·67	49·09
Percentage of Picked Fruit Injured.				
II.	Paris Green, $\frac{1}{4}$ lb. to 50 gallons. water	.	17·48	2·02
	Paris Green, $\frac{1}{2}$ lb. to 50 gallons. water	.	12·87	3·10
	Arsenate of Lead (single strength)	.	9·26	5·88
	Arsenate of Lead (double strength)	.	8·30	3·43
	Unsprayed .	.	32·78	37·82

B.—AT WYE.

	Treatment.		Percentage of Fruit Injured by Maggots.	
III.	/ Paris Green, $\frac{1}{4}$ lb. to 50 gallons. water	.	[†] 37·5	29·7
	Arsenate of Lead (normal) .	.	20·5	15·5
	Unsprayed .	.	62·5	71·5

* Grimes' Golden Apple.

† Ben Davis.

‡ Worcester Pearmain.

The strength of the arsenical wash, used at Wye, was as follows :

Acetate of Lead	12 oz.
Arsenate of Soda	4 oz. (40-50 p.c.)
Water	100 gallons.

Recent experiments have shown that this wash was not then recommended at sufficient strength for all purposes. The new formula is given in the appendix.

A great deal of good may be done in grass orchards by keeping pigs in them when the apples are falling, and some benefit has been found from the presence of poultry. Trees should also be kept clean by either using once every two or three years the lime and salt

wash or caustic alkali wash, or if Mussel Scale is present the Woburn wash in winter.

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- (1) *Goedaerdt, I.* 'Metamorphosis et Historia Naturalis Insectorum' (1662-1667).
- (2) *Slingerland, M. V.* The Codling Moth. Bull. 142. Cornell University Agricultural Experiment Station, U.S.A., p. 69 (1898).
- (3) *Theobald, F. V.* Second Report on Economic Zoology (Brit. Mus.), p. 50 (1904).
- (4) *Theobald, F. V.* Report on Economic Zoology for the year ending April 1st, 1906, p. 21 (1906).
- (5) *Ormerod, E. A.* 'Handbook of Insects Injurious to Orchard and Bush Fruits' (1898).

The Codling Moth Ichneumon.

(Ephialtes carbonarius. Zach.)

This is a well-known European parasite of the Codling Moth and is very common in some countries, notably in Spain. The female searches for the cocoons which the grubs of the Codling Moth have spun up under the bark of the trees, and by means of her long ovipositor she punctures the cocoons and deposits an egg in the grub.

A female is believed to lay one hundred and fifty eggs, one in each grub. The Ichneumon maggot on hatching from the egg feeds upon the Codling Moth larva, pupates in its cocoon and eventually hatches as a *Ephialtes carbonarius*.

The period from the egg to the hatching of the Ichneumon varies from thirty-eight to forty-six days.

It is mentioned here on account of the great fuss that has been made concerning it as a means of checking this apple maggot. It was introduced from Spain into California some while ago by a Mr. Compere. Mr. Froggatt found no trace of this parasite in the Californian orchards, and he adds, "and I might state that I have been unable to find any instance in which this Ichneumon parasite has been found in any orchard."* Further he says: "The general opinion of all the apple growers with whom I talked is that this parasite is a failure up to the present in California, and will not make the least difference in their spraying work."*

It is pleasing to find both Mr. Froggatt and Mr. Lounsbury, who have gone to see these various wonders, giving their sound and honest version of these matters.

* Journal Dep. Agri. Victoria, vol. V., pt. 12, p. 717 (1908).

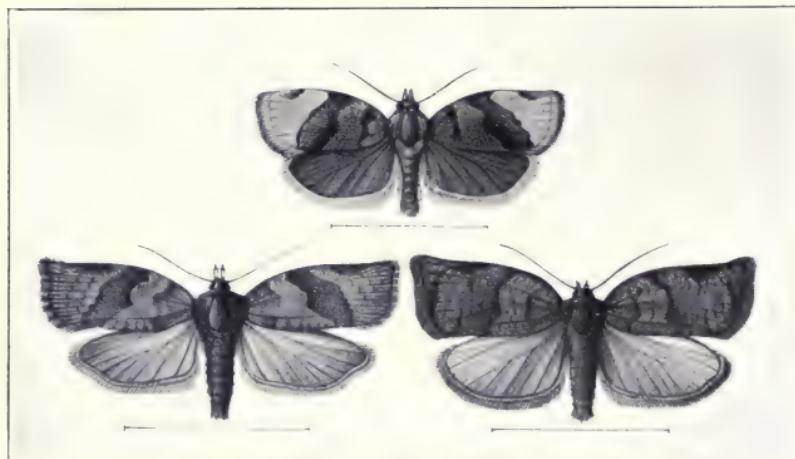
The very glowing accounts so often given of the beneficent action of introduced parasites is merely throwing back for years any possible advance that might be made in this interesting subject.

TORTRIX MOTHS ON THE APPLE.

(*Tortrix ribeana*, Hb.; *T. heparana*, Schiff.; *Tortrix rosana*, Linn.; *T. podana*, Sc.; *Sideria achatana*, Fab.; *Pyrodes rheediella*, Clerck.; and *Spilonota roborana*, Tr.)

The above are the chief kinds of Tortrix Moths which have been sent to me as feeding on the apple.

Few of the Tortricidae are to be met with on the wing before



[Horace Knight.

FIG. 71.—TORTRIX MOTHS.

Tortrix (Lozotania) ribeana.

Tortrix (Lozotania) heparana.

Tortrix (Lozotania) rosana.

June, but they go on appearing until August. The larvae are very active and can usually be told by their curious sinuous backward movements when they are touched; they have the normal number of legs, and can thus at once be told from the Winter Moth larvae. The foliage and blossom is devoured by them; the former they frequently roll up or unite together with fine silken strands, and the same is done with the blossom. In the young stages they feed more freely, however, on the leaves, etc. The pupal stage is chiefly passed in the tubes or spun-together leaves where they have been feeding. The winter is mostly passed in the egg stage, but some hibernate as small larvae in cases of debris.

Reports of damage caused by these larvae to fruit trees have been received from the Duke of Northumberland's, Alnwick; from nurseries in Worcestershire, Cornwall and Somerset; and from orchards in Kent, Surrey, Cambridgeshire, Sussex, Radnorshire and Devon.

No less than twelve species are to be found constantly at work on fruit, and many more occur now and again. The following are the most important ones on apple.

THE COMMON TORTRIX (*Tortrix ribeana*. Hb.).

The front wings are pale yellowish-brown, with dark brown markings, one at the base of the wing, a central fascia which is broader in the centre, its inner edge straight, also a small central spot; hind wings slaty-grey; wing expanse $\frac{2}{3}$ inch to a little more.

The moth appears towards the end of June and in July. The

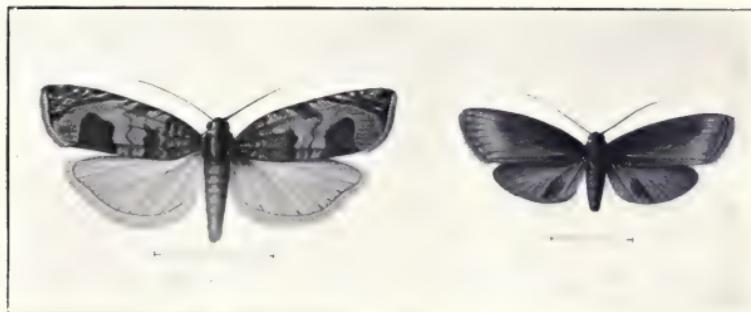


FIG. 72.

Sideria achatana.

[*Horace Knight*.]

Pyrodes rheediella.

caterpillar is dark olive-green with dark brown head and black spots; the sides yellowish-green, spots pale around their edges; slightly hairy. They are to be found from May to June on a great variety of trees and shrubs, especially apples and plums. When mature they spin up amongst the leaves and change to reddish-brown pupae, in which state they remain for two or three weeks.

ALLIED TORTRIX (*Tortrix heparana*. Schiff.).

Front wings pale dull reddish-brown and the markings dark red brown, including a basal patch, a central area broadest in the middle, with its inner edge rather angulated; hind wings slaty-grey with a yellowish fringe. Length $\frac{2}{3}$ to nearly 1 inch. Appears on the wing in June and July. The larva is bright green, with darker

dorsal line and green head. The pupa is very similar to the former. Specimens of both kept by myself pupated between the 19th of May and the 6th of June.

Tortrix rosana. Linn.

Fore wing brownish-grey, much reticulated with dark brown, edge of the basal patch very pronounced, swelling out to a dark spot on the fold; central band narrow at the costa; broad on the inner margin; central spot with a distinct line from its outer edge to the anal angle.

Appears in June and July. The caterpillar is dark olive-green



[F. Edenden.

FIG. 73.—TORTRIX LARVA (A) WITH DAMAGED FRUITLET (C)
AND FOLIAGE (B).

with white spots and brown head. This very common insect is often very harmful to young apple trees and also occurs on almost every tree and shrub.

Pyrodes (Hemerosia) rheediella. Clerck.

This little moth may often be seen in May flying in the sunshine amongst the blossoms and leaves of apple and hawthorn, and continues until June. The fore wings are dark smoky-brown, the apical portion of the wings of a brownish-orange. Length a little over $\frac{1}{3}$ inch. It does not appear to do much damage although apparently common.

Sideria achatana. Fab.

The moth appears in June and July. The wing expanse varies from $\frac{1}{2}$ inch to $\frac{2}{3}$ inch; the fore wings are pale grey, with a brown basal patch, a median brown area broken in the middle, thus forming two spots, dusky apex and brick-dust red central spot; the hind wings uniformly grey.



[F. Edenden.]

A. *Spilonota roborana.*B. *Tortrix podana.*

It is found along hawthorn hedges in the south of England. It was sent me twice from Surrey in 1897 feeding in abundance on apple.

PREVENTION AND TREATMENT.

We, unfortunately, cannot prevent the Tortrix attack as we can the Winter Moth, and at present we know of no treatment which is likely to destroy the eggs.

We are bound to spray to kill the larvæ, and to be of any help this must be done before the larvæ form those leaf-rolls or spin one or two leaves together. About mid April seems to be the time when we can catch most of these pests in the open, when they are small and have done but little damage. Arsenate of lead has been found quite successful, but two sprayings may be necessary, a second one in late May for killing some of the last hatched caterpillars.

The ordinary spraying for Winter Moth destroys the Tortrices at the same time.

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- (1) *Theobald, F. V.* Micro-Lepidopterous Larvæ on Fruit Trees. Journal S. E. Agri. Coll. No. 6, p. 13 (Dec. 1897).

THE ALLIED BUD MOTH.

(*Penthina (Antithesia) variegana*. Hb.)

This Tortrix Moth lives in a very similar way to the Bud Moth. The moth is about $\frac{2}{3}$ inch in width of wing expanse.

The front wings have the basal two-thirds brownish-black, the apical one-third clouded with grey towards the hind margin, there are also two or three black spots projecting from the edge of the central band. The moth appears in June and lays her eggs on the leaf. The larvae are thick and dark green with black spots, the head and first segment being black. They occur in early spring and may be found on the apple, pear, and on hawthorn and sloe in the hedgerows (1 and 2). The winter

is passed much in the same way as the Bud Moth, according to Newstead (3).

[F.E.]

FIG. 75.

AN "ANTITHESIA" AT REST.



REFERENCES.

- (1) *Theobald, F. V.* Journal S. E. Agri. College. No. 6, p. 18 (1897).
- (2) *Theobald, F. V.* First Report on Economic Zoology (Brit. Mus. N.H.), p. 68 (1903).
- (3) *Newstead, R.* Gardeners' Chronicle, p. 342, June 1901 and Journal Royal Horticultural Society, vol. XXVI., pt. 4, fig. 315.

THE BUD MOTH.

(*Hedya ocellana*. Fab.)

In certain years numerous inquiries are made during the summer concerning the larvæ of a small Tortricid Moth which damages the buds of various fruit trees when they are bursting and for some time after. These larvæ, which are prevalent to a greater or less extent every year, are mostly those of the Bud Moth (*Hedya ocellana*, Fab.). This fruit pest has long been known in Europe, Kollar (1) having described its ravages as far back as 1857. Since that date little has been added to our knowledge in Europe, but in 1896 Slingerland (2) published a detailed account of its life-history. The accounts of Kollar and Slingerland differ in some essential points, but the insect they write about is undoubtedly the same. It is quite probable that both observers are right, the insect living in two ways. The Bud

Moth not only occurs in Europe, but also upon the North American Continent, both in Canada and the United States. The south of England has been most affected by its presence, but it occurs in the western, midland, and eastern counties. It has been especially recorded from Bournemouth. Mr. J. H. W. Best of Suckley, Worcester-shire, tells me it is very harmful some years in his plantations. Most fruit trees are subject to its ravages, but apple suffers to the greatest extent.

The presence of this fruit pest may be detected by the early destruction of the developing buds, which on partly opening are seen to be eaten and shrivelled and which soon turn brown; these buds will be found to contain a small reddish-brown caterpillar, the cause of the injury. Later the damage is still more noticeable, the opening leaf and blossom being spun together, for both leaf and blossom buds are attacked. There may frequently be noticed a gummy appearance on the opening leaflets. The larva enters the bud, if it has not already burst, by eating down between the bracts, and there, as described by Kollar, a drop of sap forms which tends to hold the bud intact and to stop it from bursting; in any case if it does open the young leaves soon shrivel and turn brown. More usually, many of the buds fully open, leaf and blossom appearing as usual, the caterpillars later spinning the bunches of leaves and blossoms into a mass with silk. These leaf nests frequently die right away and turn brown in a very characteristic manner. Slingerland (4) states that in America the larvæ also sometimes "burrow down the stalk for two or three inches, causing it to die." This habit has not so far been observed in England; in all cases the larva boring down the top shoots of apple and pear has proved to be that of one of the Pith Moths (*vide p. 92*). When nearly mature the Bud Moth larva forms more or less of a tube by rolling up a leaf and roughly lines it with loose silk. The caterpillar at first only uses this tube as a shelter from which it emerges to feed, gradually drawing the neighbouring leaves together by silken cords. From observations made during the last few years it seems that the larvæ feed mainly at night.

LIFE-HISTORY AND HABITS.

The Bud Moth is one of the family of *Tortricidæ*. In size 1 varies from $\frac{1}{2}$ to $\frac{3}{4}$ inch across the expanded wings. The front wings are dark grey with a broad, greyish-white band across the middle with greyish spots and streaks; near the so-called anal angle is a triangular dark spot and towards the tip a leaden-grey,

eye-like spot with several black dots; the posterior pair of wings are grey. Much variation is seen in the colour of different specimens.

The moths are found on the wing in June and July at dark, and they frequent orchards, gardens and lanes. The female deposits her eggs at night, usually singly, but now and then in clusters, upon the upper sides of the leaves. Kollar (2) states that they are placed at the base of the leaf and fruit buds, and that they remain as ova during the whole of the winter. Both Fletcher (3) and Slingerland (4) found that the ova hatched in late summer and early autumn, and that the winter is passed in the larval, not egg, stage. This seems to be the rule in this country, but I have found such small larvae in spring that I am inclined to fancy Kollar's statement is also correct (1).



FIG. 76.—WINTER CASE OF BUD MOTH CATERPILLAR (a).

The eggs are flat and more or less round, transparent, and resembling little specks of gum on the leaves. When several are laid together they overlap one another like the scales of a fish. In general appearance they resemble the ova of the Codling Moth, the outer edge being marked with well-defined reticulation. The young larva can be seen developing within the egg-shell, and as it matures gives the centre of the egg a greenish hue. The egg stage lasts from seven to ten days. On hatching from the eggs the larvae at once commence to feed on the under surface of the leaves where they form little tubes of silk, open at each end and attached to the leaves near the mid rib. When feeding, the young larvae form a small fine mass of webbing, beneath which they shelter and go on feeding until the leaves are nearly ripe. By then they are nearly half grown. Before the leaves fall they repair to the base or axils of the buds and winter there, enclosed in a small silken case

usually covered with algae and dirt, as inconspicuous bodies no more than $\frac{1}{8}$ inch long; sometimes they may be found under a dead bud scale. In these "winter houses" the larvae are green. When the buds commence to swell they leave the "houses" and enter the buds, where they change to reddish-brown caterpillars with black heads, dark first segment and legs. When still more mature they become a pronounced reddish-brown. When mature, the caterpillars reach nearly $\frac{1}{2}$ inch in length. At first they live mainly in the buds in the spring, spinning the opening leaves and blossoms together, but later they feed amongst the open leaves,

uniting them together with silk. When mature they pupate in a tube of dead leaves.

The pupa is bright brown, with two rows of backwardly-projecting spines on each segment.

One brood only occurs in Great Britain. The moth is very common all over the south of England, but becomes rarer in the north.

All fruit trees are attacked by this pest, but it is especially apple and cherry that suffer in this country. It also occurs on the sloe and plum, and has been recorded from the blackberry, whilst in North America it also attacks the peach and quince.

NATURAL ENEMIES.

Five species of Ichneumon flies prey upon the caterpillars of this moth in Europe, but none have been noticed in Great Britain. In North America they also are preyed upon by three species of Ichneumons. Amongst birds we find the Blue and Great Tits (*Parus caeruleus* and *P. major*) picking the larvae out of the buds and leaf nests. The Sparrow also has been observed feeding upon them. A large Sand-wasp, *Odynerus catskillensis*, stores its nest with these caterpillars in North America. None of these natural enemies, unless it be the Paridae or Tits, do much good in keeping down this Bud Moth.

PREVENTION AND TREATMENT.

As we know that the larvae feed upon the leafage in the late summer we can, to a large extent, check the ravages of this pest by arsenical spraying. Larvae are always more easily destroyed when young, and there is not the least doubt that spraying in the late summer will kill them. There should be a second washing in the spring when the caterpillars are to some extent exposed, just when the buds are bursting, and this may have to be followed by a third dressing to kill those that escape when they are in their leaf and blossom nests. Hand-picking may be resorted to in gardens and nurseries and where single low trees are invaded, the leaf nests being easily seen and picked off by hand before the moths have emerged from the pupal stage.

Washing with caustic alkali wash does not seem to check this pest, for trees so treated in the winter of 1902 suffered severely from the Bud Moth and also Pith Moth in the following year. Probably the larval cases were hidden under the bud-bracts and in such places

that the wash does not reach, the larval cases also protecting the caterpillars within from the burning action of the wash.

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- (3) *Fletcher, Dr.* Report Department of Agriculture of Canada, 1891, p. 195 (1891).
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THE LITTLE ERMINE MOTHS.

(*Hyponomeutidae.*)

Inquiries concerning the Little Ermine Moths which attack apple trees and hawthorn hedges are some years very numerous. There are three species found on fruit, two only are important, one the Apple Ermine, the other the Hawthorn and Cherry Ermine. The apple species was separated by Zeller and is known as *H. malinella*, the hawthorn species is *H. padella*, the name by which our apple species has been previously recorded (2). The presence of the Little Ermine Moth larvae can readily be detected on account of their web or nest-forming habits.

The Apple Little Ermine Moth.

(*Hyponometa malinella.* Zell.)

The Small Ermine Moths or *Hyponomeutidae*, of which there are seven species found in Great Britain, are easily known by the leaden-grey or white front wings having small black spots spread over them, and by the habit of their larvae living under a nest of silk. Three species attack fruit, namely, *H. malinella*, Zell., *H. evonymella*, L., Don, and *H. padella*, L. The former is known as a fruit tree pest attacking the apple; it has been recorded, however, as *H. padella*, which it closely resembles. *H. padella* feeds on hawthorn, and in France on plum and cherry; in Italy on plum. Although this last species is said to be found on apple, the nest made by the larvae on hawthorn in this country certainly differs from that made on apple, being much looser. The form on the apple was named *mulivorella* by Stainton (+), but was apparently sunk as a

synonym of *pudella* by him later. Zeller described the apple form of Europe as *malinella*. It has not been generally recognised in



[F. Edenden.]

FIG. 77.—TENT OF THE CHERRY AND EUONYMUS LITTLE ERMINE MOTH (*Hypenometa evonymella*).
(Half natural size.)

England. *H. pudella* (Zeller) is apparently the same as *H. evonymella*, L.; it only occasionally does any harm, its normal food plants

being the bird-cherry (*Prunus padus*) and euonymus. It has been sent to me on more than one occasion from cultivated cherries in Kent and also from apple. Whitehead (3) says it is the species most usually met with in the north of England. *H. padella* often does much harm to hawthorn hedges, frequently quite defoliating them. In Italy it attacks the plum, being known as "tignola del pruno"; in France, cherry, plum and grapes. It also attacks the cherry in England.

The apple pest (*H. malinella*) was most troublesome in 1865, 1877 and 1880. Whole orchards were entirely devastated in the two first-named years, the foliage being as bare as in midwinter. Such an attack not only ruins the year's crop, but so harms the trees that they do not bear crops for some subsequent seasons.

LIFE-HISTORY AND HABITS.

The life-history seems to have been confused in describing this pest with that of *H. padella* (2). The fact that the same species was thought to attack both hawthorn and apple probably is the cause of this.



[F. Edenden.]

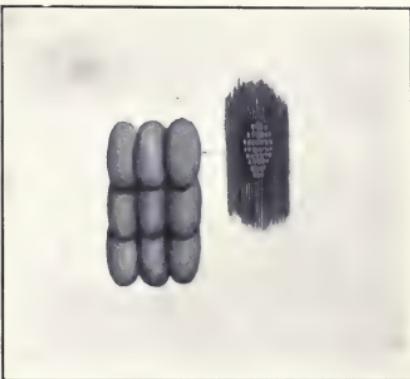
FIG. 78.—LITTLE APPLE ERMINE (*H. malinella*).
A, cocoons in leaf nest; B, adult.

England, and Carpenter records it from Ireland.

The moth appears in July and August. The earliest record I have of it is the 4th of July and the latest the 10th of August. Whitehead (3) says "they appear towards the end of June." I have never observed

The apple species (1) is smaller than that found on the hawthorn, measuring about 17 mm.; the head is white and also the palpi; the thorax is snowy-white with black spots, as also are the fore wings, which have about twenty small black spots, the cilia a similar colour to the wings; posterior wings grey, the fringe uniformly grey, thus differing from *H. padella*, in which the fringe of the posterior wings is pale grey or white with grey apex. It is found widely over

them as early as this. Specimens sent by Mr. Bear were taken on the 2nd of August. Mr. Bear sent quite a new observation, namely, that when the moths were disturbed he found they fell to the ground with folded wings and could be easily caught. As in all this genus, the female deposits her eggs on small twigs, in circular patches about one and a half lines in diameter; these egg-masses are then covered over with a glutinous substance which is at first yellow, but which gradually becomes brown, until they resemble the colour of the bark upon which they are situated. They are laid in groups of fifty to eighty; they are placed in rows which overlap one another like tiles on the roof of a house. These eggs hatch in the autumn and the minute larvæ remain under this case now composed of a glutinous substance and debris of egg-shells. As many as two to six dozen larvæ form each group and there they remain all through the winter. They are at first of a pale yellow colour with black head and dark succeeding segment and vary in length from one-half to two-thirds of a line. As soon as the buds begin to burst these little larvæ escape from the nest and enter the expanding buds and can then be easily found. In May they seem to disappear, but apparently have mined their way into the soft parenchymatous tissue of the leaves, leaving the epidermis untouched. During this period they are said to cause the leaves to become red in patches, and later to become brown, owing to their tunnelling into them. As a rule about a dozen occur in each group on the leaves. As soon as the miners are sufficiently strong they leave the protection of the leaves and feed openly upon them. They may also be found in the developing calyces of the blossoms, and feed likewise upon them. At first they retain their yellow colour, but after becoming free they gradually become a dirty ashy-grey spotted with black, and later the ground colour becomes dull yellowish leaden-grey with more prominent black spots. Soon after they vacate the blossoms and young leaves they become gregarious and live for the rest of their larval existence beneath a nest of grey silk spun at first between the folds of a leaf or leaves and later between the twigs. The small leaf nests are found in May.



[Horace Knight.
FIG. 79.—OVA OF *Hyponomeuta malinella*.
(Natural size and enlarged.)

One or both of the leaves between which they shelter becomes skeletonised and the appearance is then very marked. By June they



[P. Edenden.]

FIG. 80.—NEST OF APPLE LITTER FLY (*Phytomyza malivora*).
(Half natural size.)

make large nests and are nearly mature, and towards the end of the month they spin delicate cocoons often side by side in the nest in

which the larvae pupate and from which the moths appear in July and August. The pupal stage lasts about two weeks.

Marchal (5) also records this species as a pest to almonds in France.

The Hawthorn and Cherry Little Ermine.

(*Hyponomeuta padella*. L.)

This small Ermine Moth feeds normally on hawthorn, often quite defoliating the hedgerows. It also attacks cherry and plum. It is somewhat larger than the apple-feeding *malinella*, and differs in having the fringe of the anterior wings ash-coloured above, perfectly white below, without any dusky spot.

It measures about 22 mm. across the open wings. The head, antennae, and palpi white; the fore wings white or grey, variable in colour, with three lines of black dots, two of which are close and parallel to the interior margin, the third along the anterior edge, with other black dots near the fringe; the wings ash-grey below, about the same colour as the upper surface of the inferior wings. A few black spots on the thorax.

They appear in July and August.

The life-history is very similar to that of the preceding. The larva is of a dirty whitish-yellow colour, with black head, and two dark spots on the first segment, forming the thoracic shield, and another the anal plate; thoracic legs black. A median dusky line is present along the back, and on each side two rows of eleven round spots, brown in colour and slightly hairy.

The pupa is yellow in the middle, brownish-black apically, and the same colour on the wing cases. They live and pupate much as in the former species, but the cocoons are much thinner, so much so that the pupa can be seen within, whilst in *H. malinella* they are densely white, compact and opaque. They are placed differently also; for in *malinella* they are in group-like packets, in this species they are never found in groups, but are more or less isolated, nor is the tent nearly so compact as in the apple-feeding species.

PREVENTION AND REMEDIES.

Washing with arsenates has but little effect upon these pests, owing to their feeding between the silken nests, which protect the leaves from contact with the wash, but it nevertheless does some good, especially where arsenate of lead is used. Whether spraying with caustic alkali wash in winter would kill the young larvae is

also doubtful, if used at the strength generally employed, but it can be used at double that strength on dormant wood, even if 98 per cent. strength of commercial caustic soda is used. The stronger solution would, I feel sure, destroy the glutinous cover over the young caterpillars. General observations have tended to confirm this view. The tents should always be collected as soon as they are seen forming, and burnt with their complement of larvæ, or collected and put in pails of quicklime. Those high up may be cut off with long-handled shears, such as are used for tree trimming.

The species on hawthorn hedges may be destroyed on a large scale by beating the hedges with supple sticks, and treading on the caterpillars as they fall down, or with lighted torches.

NATURAL ENEMIES.

The Little Ermine Moth caterpillars are preyed upon by Starlings, which greedily devour them, and I have bred an Ichneumon in numbers from specimens collected in Kent.

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- (4) *Stainton, H. T.* 'Lepidoptera Tineina, Insecta Britannica, vol. III., p. 60 (1854).
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THE PITH MOTHS.

(*Blastodaena hellerella*, Dup., and *Blastodaena rivotentella*, Herr-Schaff.)

The Pith Moths are small Tineid moths whose larvæ cause a good deal of harm to apple trees. The damage done is particularly noticeable in nursery stock, but bush apples are affected in the orchards. The larvæ tunnel into the buds, spurs and shoots, and kill them. The leaves and blossom flag, then gradually turn brown and die. The dead parts may remain on the trees some time or they may fall off. Buds are killed in late autumn and winter. The attack of the Pith Moth larvæ may at once be told from that of the Bud Moth by the

absence of spun together leaves and blossom and by the whole mass dying back. Very similar effects are produced by canker. It has also been reported attacking pears (1). It is a widespread pest, having been recorded from Worcestershire, Herefordshire, Gloucestershire, Cambridgeshire, Bournemouth, Sussex (Hailsham and Polegate), Surrey and Kent (1), and in Ireland it is recorded by Carpenter (6) from Donnybrook.

LIFE-HISTORY AND HABITS.

The moth of *vinolentella* has a wing expanse of a little less than $\frac{1}{2}$ inch; the front wings may be almost entirely black, or may be marked with dark brown, and rusty brown; the inner margin of the fore wings is white to beyond the middle, where an irregular faint oblique white bar proceeds to the tip of the wing, and two branches from this intersect the black apical portion. The hind wings are grey and densely fringed; the head black. Carpenter (6) says the true *Laverna atra*, Haworth, is characterised by a white head, and that the black-headed form is *B. vinolentella*. The specimens I have bred have had both black and white heads. The white-headed species is *B. hellerella*.* The moths appear in July and on into August. The egg stage is unknown. The larvæ hatch in late summer and feed first of all on the leaves, later they bore into a bud, and still later under the rind of a spur or shoot near a bud and remain there all the winter. Their presence can be detected by a small round hole near the bud and a brown blister-like patch where they have been working. In spring they tunnel up the shoot, which if broken off will be found to contain the Pith Moth caterpillar or pupa, usually situated near the apex of a shoot.

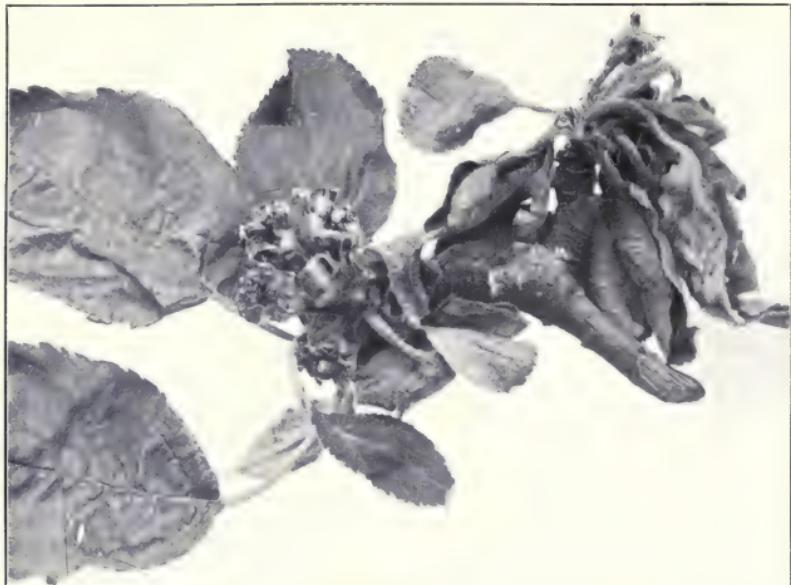
The larva is dull reddish-brown with a deep brown head and



FIG. 81.—PITH MOTH AND DAMAGED SPUR (*B. hellerella*).
(Natural size.)

* The white-headed species common in Kent is *B. hellerella*, Dup.; the black-headed species is *B. vinolentella*, H. S. (rare in Kent and Worcester). The species I originally referred the Pith Moth to—*Laverna atra*, Stainton, following Miss Ormerod—is the black-headed *B. putripenella* of Zeller.

first segment; the other segments show more or less traces of pale brown spots, four in a row on the second and third segments and



[F. Edenden.]

FIG. 82.—APPLE SHOOT ATTACKED BY PITH MOTH.

(Right hand spur showing flagging.)

four placed in a quadrangle on the remaining segments. The two anterior segments have two lateral spots and the remainder a single lateral spot. The apex is deep brown. When mature they reach

$\frac{1}{3}$ inch in length and then pupate near the apex of the shoot they have tunnelled. They reach their full-fed stage during the last two weeks in June. If the dead shoots are picked off, the moths can be easily bred. They are very active, running and flying readily.



[H. Knight.]

PITH MOTH (*Blastodacna hellerella*).

mahogany red. It is cylindrical in form and about $\frac{1}{4}$ inch long. On the ventral surface of the penultimate segment are two blunt

The pupa is of an ochraceous hue; the head and front of the thorax and tip of the body

processes separate and diverging outwards, hairy at their apices; the eyes are black and the wing cases and legs long, the former pointed. This stage lasts from two to three weeks, the moths emerging from the end of June into mid August. The pupæ may sometimes be seen projecting from the dead shoot. Now and again the red larvae leave the shoots and pupate amongst the dead leaves. The minute differences of the larvae and pupæ of the two species have not yet been made out.

Mr. W. Bear says the attack becomes evident at Hailsham in May (3).

PREVENTIVE MEASURES.

It is quite obvious that there can be no remedy for this pest, but we can do much in the way of prevention by hand-picking the dead shoots before the moths emerge in June. This can only be done, of course, where small trees are attacked, and it usually happens that it is only on such trees that the attack takes place, but I have known large bush trees attacked. The larvae may be killed by cutting off attacked parts in winter, easily told by the characters previously given (*vide* Fig. 84).

Late spraying with arsenate of lead might prove beneficial, as it would kill the young larvae, which seem to feed first of all on the leaves. Of course, care must be taken in regard to the fruit. The trees should be washed as soon as the fruit is harvested; a heavy spraying should be given.

The time to spray therefore must depend on the variety of apple concerned. This is certainly worth giving a fair trial, as beyond



(F. Edenden.

FIG. 84.—WINTER STAGE OF PITH MOTH, SHOWING BLISTERS AND HOLES.

hand-picking we can do nothing to check the increase of this pest, so noticeable during the past few years.

Some varieties seem more liable to it than others. Mr. Smith of Linton found that Worcester Pearmains were attacked, but not the alternate rows of Lord Derby (4).

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- (5) *Ormerod, E. A.* 'Handbook of Insects Injurious to Orchard and Bush Fruits,' p. 275 (1898).
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THE APPLE LEAF MINER.

(*Lyonetia clerckella*. Linn.)

This Apple Leaf Miner was unusually prevalent in 1903 and, in a few cases reported, damaged the foliage of dwarf apple trees very considerably. In one instance the attack was personally investigated in Huntingdonshire and every leaf on two trees was found to be tenanted by the larvae of this minute Tineid.

The leaves which were attacked had more or less shrivelled, and many had died away in August, the trees thus receiving a serious check, as the sap was still flowing freely. This insect also appeared in plenty in my own garden at Wye, which enabled me to keep it more or less under observation.

The presence of this leaf miner is easily told by the long, sinuous tunnels caused by the larvae burrowing in the leaves. As a rule, a single tunnel occurs only on each leaf, but where the damage has been noticed, as many as four have been present, the greater part of the chlorophyll being thus destroyed.

This moth occurs in most parts of England; it has been especially recorded from Cambridgeshire, Huntingdonshire, Middlesex, Surrey, Kent, and from Bristol, Darlington, Manchester, and various parts of Yorkshire.

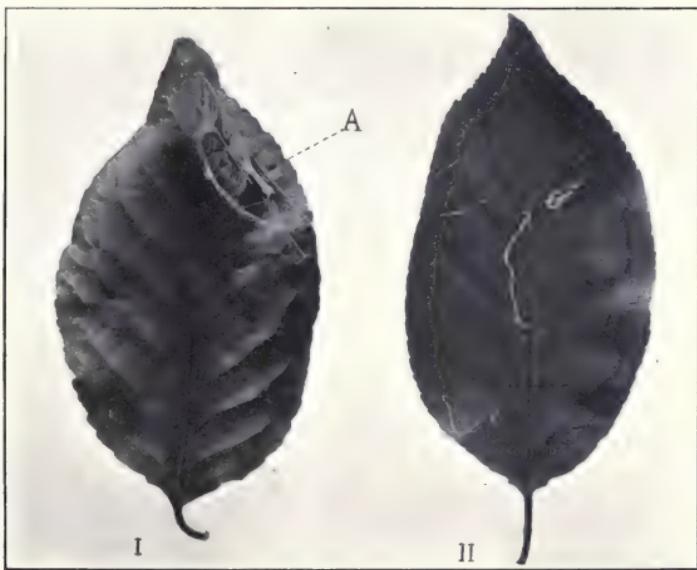
I do not know of any previous record of its doing any appreciable

amount of damage to fruit foliage, but it has frequently been sent since.

As will be seen from what we know at present of its life-history, there is no vulnerable point at which we can direct our energies when it increases sufficiently to become a pest.

LIFE-HISTORY AND HABITS.

The moth appears in April, June, August and September and again in November. It is about $\frac{1}{3}$ inch across the expanded wings ; the front wings are narrow and lanceolate, brownish-white, with a long



[F. Edenden.]

FIG. 85.—THE APPLE LEAF MINER (*Lyonetia clerckella*).

I, cocoon, seen at A ; II, larval mine.

brown line beyond the middle with a narrow fuscous fascia and three fuscous streaks, at the apex is a prominent black spot, the fringe is brownish-grey and so are the hind wings and their fringes. Some specimens have the fore wings almost bronzy, especially after death, the colours quickly darkening ; the abdomen is clothed with shiny steely scales and the dusky antennæ are long and slender, the legs are shiny brown with pale tarsal bands and the hind legs have prominent tibial spurs.

The females (and possibly the males) hibernate in crevices, under rubbish, especially where they can keep dry. Some were found in

midwinter in box hedges in my garden. The first sign of larval life may be noticed in May. The female as a rule deposits one minute egg on each apple leaf or sometimes cherry leaf. In (at present) an unknown period the larva hatches and bores into the leaf and there forms a twisted and serpentine tunnel (Fig. 85) in the leaf, feeding upon the soft parenchyma. Although I have been unable to note the egg it is evidently laid upon, not in, the leaf, as a minute hole can often be seen at one end of the tunnel through which the larva has doubtless entered. The larva gradually enlarges this tunnel as it grows; at its end it is usually $1\frac{1}{2}$ mm. across. The tunnel may be brown, black or grey, the larger end usually showing a median line of dark "frass." Inside this tunnel will be found the green caterpillar varying from pale to deep apple-green. It reaches when full grown 6 mm. in length; the segments are



(Horace Knight.

FIG. 86.—APPLE LEAF MINER (*Lyponetia clerckella*).

deeply constricted and more or less rounded; the head is dark, and there are two dark patches on the first segment and also a hair on each segment. In general form the larva is flattened. The six jointed-legs are brown and the eight prolegs also brown to almost black. Larval life seems variable, for some were mature four weeks after the first signs of the tunnels were noticed, others not until five weeks. The larva can be seen in its tunnel by holding the leaf against the light. They fit in so closely that they can scarcely move towards the end of their growth.

When mature they leave the leaf by eating their way out of the gallery and crawl about upon the leaves for a short time. Usually in a few hours they commence to spin a cocoon on the leaf. These cocoons are generally spun on the under side of the leaves but may occur on the upper side, the latter only when they settle

upon small or curved leaves. Very often the cocoon is spun on the leaf in which the larva has tunnelled, or it may be on a fresh leaf. This case is formed of very fine shiny white silk, and is made in well-formed examples, as follows: a thick strand extending from one branch vein to another on each side, usually parallel and about 5 mm. apart. The length of these lateral strands depends upon the distance of the ribs apart. I have measured some 30 mm. long. The cocoon is spun between these and attached to them by another strand of silk on each side. The cocoon itself is cylindrical and open at each end. They may also occur with the threads running from the mid rib to the edge of the leaf. The pupa is pale apple-green, the front fawn-coloured and also the wing cases. The third segment of the abdomen has a large apical yellow patch, and the base of the fourth is also yellow, the venter pale green, with the tips of the leg cases black, also the eyes. It is formed a few days after the larva has commenced to build the nest. It is notched in front, and behind the antennal cases stick out as two prominences. The leg cases and wing cases are long and prominent, and there are black marks noticeable at the apices of all the legs. The pupa is 3·5 mm. long.

The pupal stage lasts from ten to twenty days. The larvæ found in April give rise to a brood of moths in June and July. These lay their eggs again, and we find the larvæ occurring in July and beginning of August. They mature and give rise to a third brood in September and October. This latter brood of moths hibernate, but those that occur early in September, may lay eggs and produce another generation of larvæ which mature in the middle of October and join in hibernating with the late-hatched previous brood.

PREVENTION AND TREATMENT.

It is extremely difficult to say what to do in such an attack, but fortunately it is usually limited to a few trees, and these usually pyramids and espaliers, where hand-picking can be carried out. The whole life seems to be spent on the tree in a protected condition, the only time the larvæ are free being when they leave the tunnels and commence to spin. They then take no food, and as they hatch out irregularly, two broods even overlapping, nothing can be done to destroy them. All we can do seems to be the rather drastic measure of destroying all the leafage in September by means of a strong arsenical wash and so killing the larvæ and pupæ, or constant spraying with paraffin emulsion in the spring to prevent egg-laying.

It is certainly worth while to hand-pick trees that are attacked

constantly, so as to exterminate the moth, which may occur under certain conditions in dangerous numbers. This is especially to be borne in mind by growers, for we can hold out less hope of combating this insect than the Pear Midge, which still to some extent baffles treatment and yet has a distinct period in its existence when we should be able to destroy it.

In examining specimens sent from Huntingdonshire I found many of the larvae dead in their galleries. Each of the dead ones contained the larva of a Chalcid which had destroyed it. These natural enemies, unfortunately, did not hatch out.

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THE WILD CRAB LEAF MINER.

(*Nepticula malella*. Sta.)

This small mining Tineid Moth was reported from Kent as being very abundant on apple trees in the autumn of 1906 (2). In one case nearly every leaf was found to be mined in early October. Many of the leaves had fallen in the latter part of September owing to this little insect's depredations. At this time of year, the damage is, of course, not serious, but the loss must, to some extent, check the final annual growth, especially in certain young trees.

The mine caused by the larva is very characteristic. It starts as a small, thin, sinuous tunnel, which gradually swells out into a blister-like area, at first green, and then becoming yellowish-green.

Stainton (1) who gave an excellent account of this moth, describes the mine as greenish-orange. None were seen of those sent in which any orange tone appeared, but the identification is beyond doubt. One very noticeable feature is that the track of the larva is marked by a dark, sinuous line of black excrement.

As many as six mines were frequently seen on one leaf. All varieties of apples seemed to be affected but Cox's Orange Pippin; no trace could be found on any of the latter, although they were growing amongst attacked trees and the leaves were still firm. The early maturing of the leaves may have something to do with this.

Should this moth continue in abundance in the following year after an autumnal attack, it might cause a good deal of harm, as the first brood attacks the leaves early in July.

The distribution is very wide in England, specimens having been reported from Devonshire up to Yorkshire. I believe it occurs in Scotland, and Stainton records it from Dublin.

It is now, just as mentioned by Stainton in 1855, very common in the London district. In 1887 it was quite harmful at Kingston-on-Thames.

LIFE-HISTORY AND HABITS.

The moth appears towards the end of May. The female places her eggs on the underside of the leaves, in most cases close to the mid rib, from which area the mine first commences. Now and again it is placed on other parts of the leaf.

In colour, the moth has almost black anterior wings, with a bright pale (almost white) band across each on the apical half; the



[Horace Knight.

FIG. 87.—*Nepticula malella*.

hind wings are grey and also the fringes. The thorax is dark, and the abdomen grey.

In length it reaches 4 to 5 mm.

The larval mine is at first very thin, and gradually increases in size, widening somewhat as the "miner" grows; suddenly it swells out into a more blister-like area of pale hue, the exact track of the larva being marked by a dark line of "frass." The larva is pale amber-yellow, with a dark central line, sometimes brown, at others with a red tinge; the head is brown, and the body slightly hairy. When full fed it reaches about 4 mm., and then eats its way out of the leaves from the upper surface.

The free larvae seek shelter at the base of the leaves, in any crevice, or even fall on to the ground, and then spin oblong oval cocoons of dull yellowish silk.

The second brood of moths appear in early August, but some

years not until the middle of the month, and these produce the larvae which make the mines seen in September and October.

In the autumn of 1906 the second brood of larvae had matured mostly by the second week in October, but a few were found in the leaves as late as the 4th of November.

They winter in the pupal stage in crevices on the trees, around the buds, etc., and in any convenient shelter.

It was said by Stainton (1) to be common on the wild apples in the hedgerows. In this way invasion can always come to an orchard. Fortunately, wild apples are scarce. It has also been observed on

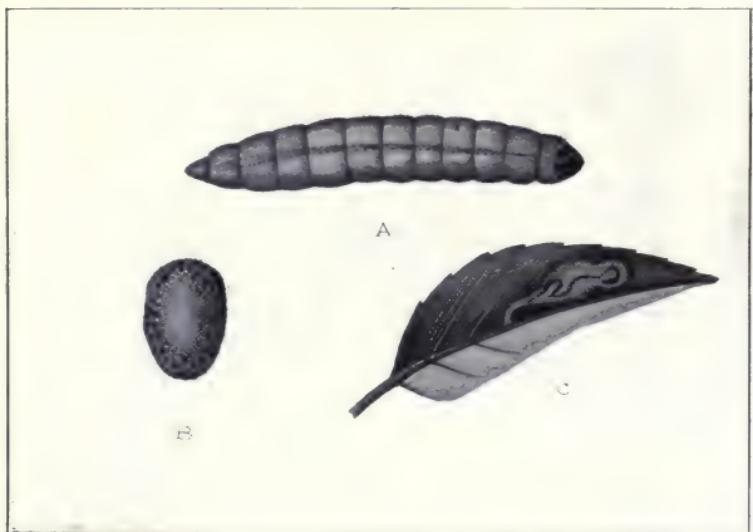


FIG. 88.—APPLE LEAF MINER (*Nepticula malella*).

A, larva ; B, cocoon ; C, mined leaf.

the medlar and quince, but so far not on hawthorn. A number of the larvae were found dead in the mines in the autumn. The cause of this could not be traced.

TREATMENT.

As far as can be seen at present the treatment for these Apple Leaf Miners is somewhat difficult, but it is possible that a good dressing of lime wash would so coat the little cocoons that the early brood of moths could not escape from the cocoons.

In nurseries it is advisable to hand-pick any mined leaves in July, before the escape of the larvae.

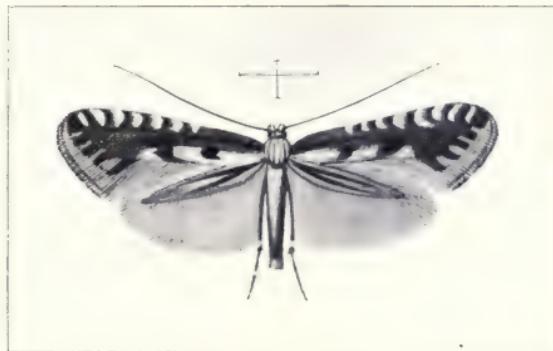
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THE APPLE LEAF-BLISTER MOTH.

(*Ornix petiolella*. Sta.)

Amongst several specimens of apple leaves sent during the year 1907 damaged by mining larvæ, some were found to be attacked by the little Tineid known as *Ornix petiolella*. The mine formed by this species is a rough blotch, like that of the nut species (Fig. 201),



(Horace Knight.

FIG. 89.—*Ornix petiolella*.

and is on the upper surface of the leaf. The larva found in these blisters is greyish-green to olive green in colour, the third to tenth segments have six pale spots, four in a row in front and two behind; from these arise short stiff hairs. In length, the larvæ may reach 7·5 mm. They are found in June and again in September. When mature the larva leaves the blister and spins the two sides of the leaf together, which forms a nest over $\frac{1}{2}$ inch in length (Stainton (2) says an inch); within this the larva, which finally assumes an orange-yellow hue, spins a dull yellowish cocoon.

The moth first appears in May. Its wing expanse is from 10 to 12 mm. The front wings are deep brownish-grey; on the costa are seven or eight white patches, and on the inner edge also are some whitish markings; the fringe has two external thin black lines from the costa to the anal angle. Posterior wings grey with long

grey cilia. Thorax spotted white and grey. Abdomen deep grey; apex ochreous; legs grey and white scaled.

The moths fly towards evening; very few are seen in May, but in the late summer the second brood is quite abundant in some trees. It does not, however, seem to do much harm (1).

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THE APPLE BLOSSOM WEEVIL.

(*Anthonomus pomorum*. Linn.)

In cold and unfavourable weather, when the flow of sap to the developing apple blossom buds is checked, and their opening retarded, much damage is often wrought by the larvae of a small weevil, known as the Apple Blossom Weevil, the *Anthonomus pomorum* of Linnaeus. This pest has been known for a considerable number of years as an insect injurious to the apple. Mr. Knight, in his 'Treatise on the Culture of the Apple and Pear,' published in 1801, refers to this weevil as being particularly "fatal to a larger proportion of the blossom, when the time of its expansion has been preceded by hot and dry weather." Kollar (1) also refers at length to this pest. Not only is the apple blossom attacked by this species of weevil, but the pear also. Canon Fowler (2) in his work on beetles, says it is "apparently uncommon in the London district, Kent and Surrey." This statement is, however, far from correct; for, in Kent it is a terrible pest, and it is nearly as bad in parts of Surrey (10). This weevil is also very harmful in Worcestershire (11).

LIFE-HISTORY AND HABITS.

As soon as the first warm days of spring come, the beetles leave their winter shelter, and, after being fertilised by the male, are ready to lay their eggs. The ova, which are white oval bodies, are deposited in the blossom buds before they open. How the females reach the buds is still an undecided question. They are provided with wings, but they seldom, it appears, make use of them. Kollar says, "nor are they seen flying from branch to branch." White-

head (3) states that they "fly and crawl" to the branches. Curtis (4) avers that "the females will not readily fly," but that "the males are seen on sunny mornings flying among the trees in search of the females, who generally are crawling over the branches." Mr. Whitehead (5) again in his pamphlet states that "the female by flying or crawling finds its way to the blossom buds." The males are often taken on the wing, but seldom females, although the orchards are teeming with this beetle. The adults are extremely timid and fall at the least vibration. Of those fallen upon the ground, very few crawl up the trunk so as to regain the branches. Now what becomes of the others unless they fly back to the tree or to other trees? Although the females do not readily take wing, yet they undoubtedly do fly from the ground into the branches, especially on warm, sunny days. I am sure that the females fly more than we imagine. In any case the recommended grease - banding will not catch them, which it might do if they crawled up the trunks of the trees as has been averred by some people, not naturalists. Copulation undoubtedly takes place upon the branches. The female deposits her eggs in the blossom buds before they open. As soon as the blossom commences to expand she leaves off ovipositing, as the larvæ could not live in an open blossom. Thus it will be seen that cold, damp weather, in spring, especially nights with frost, keeping back the buds, extends over a greater length of time the egg-laying period of the female. A single ovum is deposited in each blossom, but several possibly in a blossom bud.

The act of oviposition takes some time, usually at least three-quarters of an hour, so that a single female cannot lay very many eggs if the blossom buds expand rapidly, as they do in fine, warm weather. Oviposition continues for two weeks, about fifty eggs being laid. Mr. Whitehead says 15 to 20 eggs. I have often taken females which by dissection have shown 50 and even 60 ova in them. If we watch a female we shall see her wandering about upon



[Horace Knight.]

FIG. 90.—APPLE BLOSSOM WEEVIL
(*Anthonomus pomorum*).

the various buds, and at last, settling upon one in particular, she commences to bore a hole into it by means of her long proboscis. When she has reached the centre of the bud, a cavity is formed by means of her spatulate rostrum. Then reversing her position, she lays an egg in the hole, and again turns round and pushes it far into the cavity with her snout. The aperture thus formed is very minute, and cannot easily be seen with a lens. The hole is afterwards closed up by the female with saliva, a similar habit to that which we see in the Corn Weevil (*Calandra grunaria*). In from five to seven days these ova hatch into small, white, footless maggots, which at once commence to feed upon the stamens and other internal parts of the blossom, and later on even upon the receptacle. They rarely touch the ovary. The blossom commences to expand, but the petals seldom completely open. The growth suddenly ceases, the petals which form a kind of brown cap over the receptacle, shrivel up and die, presenting a scorched appearance. On this account the disease is spoken of as "capped blossom." On opening one of these diseased-looking blossoms there will be found a small, white, maggot lying in the centre. At first this footless maggot is a pure white grub with a dark brown head. As in all the weevils, the larva lies in a curved position; by degrees it assumes a creamy colour, and the skin becomes more and more wrinkled. The spiracles are dark brown, and there are a number of scattered hairs over the body; on the ventral surface are some pointed tubercles, by means of which the larva can move in the cavity of the blossom. When full-grown the larva is $\frac{3}{16}$ inch in length, having reached maturity in from ten days to two weeks. The period of larval life is, however, very variable, some may reach the full-fed state in about eight days, others taking three weeks, this variation depending entirely upon the weather. On the larva reaching maturity it casts its skin and assumes the pupal state, still inside the blossom, which is now practically dead. The pupa is pale yellowish-brown, and with the various parts of the imago marked out upon it, the long proboscis being particularly noticeable, folded under the head and lying between the leg cases. The pupa, which is slightly smaller than the larva, hatches in from seven to ten days. The eyes, which are clearly seen, are black in colour, contrasting strongly with the rest of the body.

Soon after the adult beetle has come forth from the pupa case it commences to eat its way out of the dead, brown blossom, leaving behind a round hole, from which it has made its exit. The weevil rests for a short time, some five or six hours, and then it commences

to feed upon the leaves of the apple for the rest of the summer months. Some naturalists say they do not eat the leaves but exist upon the adipose tissue stored up in their body. About the middle of the autumn they look about for some shelter in which to hibernate during the winter months, such, for instance, as under the rough bark of the trees, beneath stones and any rubbish on the ground; from where they will come forth in the following spring ready to attack the blossom again.

The adult beetle (Fig. 90) is described as follows by Fowler:—
 " Pitchy-black or fuscous-black with ashy pubescence; head thickly pubescent with an impression on the forehead; rostrum long, slender and curved; antennæ long and slender, reddish, dusky at apex; thorax pitchy, sometimes rufo-piceous at sides, with rather scanty, coarse, white pubescence; scutellum thickly pubescent; elytra pitchy, sometimes pitchy-ferruginous, with alternate bare and white fasciae, the one behind the middle composed of whitish pubescence being oblique and much the most conspicuous, punctured striae distinct and rather strong, interstices very closely punctured; legs more or less pitchy, but variable in colour; femora always more or less dusky, anterior pair with very strong tooth, intermediate and posterior with much smaller teeth; length, 3 to 4 mm. (about $\frac{1}{8}$ to $\frac{1}{6}$ inch)."

Roughly speaking we can recognise this Blossom Weevil by the pale V-shaped mark on the wing cases.

The attack of this beetle may be told first of all by the presence of the beetle itself in the early spring upon the apple branches; a good jarring will soon cause them to fall off and show their presence. The surest sign is the scorched appearance of some of the flowers and their often failing to open, whilst other blossoms are fully expanded. The larvae are unable to live in an opened bud, hence in fine weather, when the blossoms expand rapidly, many of the young larvae die before they have damaged the bud, and in many cases the blossoms may expand before even



[F. Edenden.]

FIG. 91.—APPLE BLOSSOM WEEVIL (natural size and magnified)
AND "CAPPED" BLOSSOM, SHOWING EXIT HOLE AT A.

the ova are hatched, and thus all damage caused by the maggot is prevented.

In most cases the invaded blossoms fall when the larvae have reached maturity, in any case they will fall if the trees are shaken, and we must remember that the pupae are still in these dead inflorescences when they fall or are shaken to the ground. Those from which the beetles have escaped can at once be detected by the large round hole near the base of the blossom. So great a number of these Coleoptera appear in some seasons (especially noticeable for the reasons given above, when there have been dull, damp and frosty nights) that as much as 40 per cent. of the apple crop has often been destroyed by them. It is particularly abundant in Kent, and is also extremely destructive in Worcestershire, Cambridgeshire and in other counties. Miss Ormerod (1) records a case at Redditch in which 25 per cent. of the blossoms were damaged. This is, however, nothing to some attacks. The usual time for the beetle to be seen is about the first week in April, and from then right on through the summer. The diseased blossoms commence to show from the middle of May to the middle of June. Both early and late apples are alike attacked, none as far as I know being immune against this pest. The middle crop suffers most of all.

With regard to pears, the damage is comparatively slight, *A. pomorum* only occasionally visits that fruit tree.

PREVENTION.

With regard to preventive measures, there are several points dependent on the natural economy of the pest worth considering. First, with regard to preventing a future attack. The blossoms that show a backward state and become brown at the tips, are those that contain either the larvae or pupae of the beetle. They readily fall if the tree is jarred—in fact, great numbers do without being shaken; they can then be collected and burnt, thereby destroying many of the weevils that will not only live upon the leafage during the summer, but also hibernate and come out and place their eggs in the buds next year. Care must be taken to do this soon enough, that is, before the weevils have escaped from the dead blossoms. This would be sure to lessen very largely the amount of future attack.

Several fruit-growers have told me that they have seen weevils in the grease bands when they have been left on late. There does not seem sufficient evidence, however, to justify grease-banding for this

pest, as so many of the beetles hibernate high up and others undoubtedly fly on warm days. All personal observations made have failed to show that *any* weevils are caught in the bands. One caution must be given, that is, not to follow the advice of banding with tar, a sure method of killing the tree, as all fruit-growers know, if persisted in.

Needless to say, all the rough bark should be scraped off the trees so as to do away with one of the winter habitats, whilst all rubbish, dead leaves, and so forth, under the trees, should be burnt in the winter.

As to the possibility of spraying being of benefit, there is some difference of opinion. Whether an odorant or an arsenical poison is best remains to be decided. Certainly, spraying the trees before the blossom buds burst, about the time the beetles appear, with *kerosene emulsion* is of no value.

It may be possible that some form of arsenate for spraying might poison the beetles whilst boring the holes for the eggs into the buds with their proboscis. The only instance I find recorded of this method is in one of Miss Ormerod's reports (1), where it is stated it was not attended with any success. What arsenate was used I do not know. I have never found any benefit from this treatment. Mr. J. H. W. Best, writing from Worcestershire, says he thinks that the lime and salt wash has reduced them to some extent. At present, however, it seems no form of spraying is of much use.

"Jarring" for the beetles is the best plan; the beetles readily fall on being shaken, and if a tarred board or cloth be held underneath it is surprising how soon an orchard can be cleared. The best plan is that adopted in American fruit orchards, namely, of attaching at each end of a piece of cloth about two yards square, a rod of wood, and to these in the middle, another rod placed lengthways, overlapping one end so as to form a handle, and also to keep the two end rods expanded. The cloth can be either smeared with grease or tar, or any other sticky substance in which the weevil cannot crawl.

In England this beetle is found abundantly in the west, south and south-east, less common in the north, but often very abundant in the midland counties. I have taken it in both north and south Wales. In Ireland it is found in abundance, at times, near Dublin, and it is also found in the north. I have not heard of its destructive habits in Scotland, but it is recorded from Edinburgh. In France it is very abundant around Paris, and is a general pest in

French apple orchards. Germany and Austria are also countries in which it is found.

Recently it has apparently appeared in America, Dietz recording it in the Transactions of the American Entomological Society (8); and Dr. Lintner (9), in his list of Apple Insects of the United States, also records its presence.

Miss Ormerod, in the report referred to before, says: "Anything deterrent, such as common whitewash with a little paraffin in it, or soft soap, with a little paraffin or sulphur added, and well applied to the stems and branches, would be likely to be of some service in keeping off attack."

What one must aim at, I fancy, most of all in this attack is the destruction of the diseased blossoms, and the jarring off of the beetles on to tarred cloths; whilst the destruction in the winter of the lichens, etc. (as well as the cleaning of the bark), by spraying the trees with either lime and salt or caustic soda wash is advisable.

NATURAL ENEMIES.

Amongst the natural enemies of the Apple Weevil is an Ichneumon fly of the genus *Pimpla*, which deposits its eggs in the Weevil larvæ. The Tits (*Paridae*) and Woodpeckers (*Picidae*) also eat them greedily, especially the hibernating beetles.

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THE FRUIT BARK BEETLE.

(Scolytus rugulosus. Ratz.)

The damage caused by this Bark Beetle seems to be on the increase. It is recorded from Devon, Worcester and Kent. Writing in July 1906, Mr. Lewis Levy of Borden Hall, near Sittingbourne, says: "We have a plum tree which has just died, and find numerous tunnels between the bark and the wood, and also in the latter." The specimen sent and the damaged wood, proved the culprit to be *Scolytus rugulosus*. Numerous trees were observed in Worcestershire, several of which had been killed, and others were dying from the effects of this Bark Beetle.

The worst attacked specimen seen was sent me by Mr. Gardner of Ombersley, who very wisely destroyed the infested trees. Part of this tree given me is reproduced here (Fig. 93).

The beetle has somewhat varied food. It seems to have, however, a decided preference for apple and plum. I have seen pears similarly attacked, but never cherries.

The Board of Agriculture Leaflet (No. 49) says also peach, apricot, nectarine and quince. In some cases it seems that the beetles prefer to oviposit in the smaller branches and twigs, which thus wither and die. The leaves soon show signs of their presence by wilting, dying later and turning brown; the bark then cracks and eventually peels off.

Most cases recorded and seen during the past few years have been attacks on the stems of trees from eight to fifteen years old. In one case the whole stem from five feet above the ground into the branches was riddled with shot holes—the "flight holes" of the beetles. Whilst on the smaller boughs and twigs the bark readily cracks and splits off, that on the stem was noticed to remain in its normal position. On removing the bark one finds that the shot holes lead down through it to the wood, in the soft sappy layer of which the larval scolyti may be seen working and sculpturing galleries, which



(Horace Knight.

FIG. 92.
BARK BEETLE (*Scolytus rugulosus*).

run mainly up and down between the bark and wood. From these median channels run, on either side, smaller ones, in which the larvae live. There is a popular idea that only sickly or unhealthy trees are attacked. That they are so more than others is very probable, but perfectly sound trees suffer in the same way.

The mere fact that we find larvae and pupæ in the dying and dead wood does not necessarily show that the beetle only attacks such wood. The larvae have caused the unhealthy state or have killed the tree themselves, and have to finish their development where they have lived.

From various observations made, it appears that when once a tree is invaded it forms a centre that attracts the beetles to oviposit, and thus if we only destroy it at the right time, we can use these damaged trees as "trap trees" are used in forestry. Both old and young trees suffer. In an old orchard where trees have never been tended, it is no unusual thing to see many of the smaller



[A. V. D. Rintoul.

FIG. 93.—PIECE OF PLUM STEM SHOWING "FLIGHT HOLES" OF BARK BEETLE (*S. rugulosus*).

(One-third natural size.)

branches and twigs bared of bark and showing up pale against the rest of the wood. This is usually due to this beetle.

From these old neglected trees they invade young and sound ones.

LIFE-HISTORY AND HABITS.

The beetle that is the cause of this damage is quite small, often no more than $\frac{1}{10}$ inch. In colour it is nearly black, with some-

what brown elytra, legs and clubbed antennæ. The thorax is finely punctate, and the elytra have lines of punctate striae. The beetles may appear in April and May, but they certainly more usually occur in June in Kent, and are also said to occur in July. Another brood occurs in October; specimens were bred out from the wood sent by Mr. Lewis Levy in early October in 1906, and some a little later in the year were sent me by Mr. Furley, from Worcestershire.

It thus looks as if we had three broods during the year, to some extent overlapping.

The beetles bore into the wood to deposit their eggs; they tunnel upwards along the bark a little way, and then into the bark. They then form a tunnel often nearly an inch long, between the bark and the wood, the sculpturing being more pronounced on the latter than the former. These so-called "mother-galleries" are almost straight, and pass up the tree, and along their sides the females lay their eggs. The length of the egg stage has not been followed, but in a few days small white footless

larvæ appear, and tunnel outwards from the parent gallery. When mature the larvæ pupate at the end of their galleries, often forming a deepened chamber into the wood. The beetles then escape through the bark, and leave behind the innumerable small shot holes.

There have been counted some fifty larvæ coming from one "parent gallery": how many more may occur is not known.

The winter seems to be passed mainly in the larval stage under the bark of the trees, and thus damage is done during the whole year.



[F. Edenden.

FIG. 94.—WORK OF THE BARK BEETLE (*Scolytus rugulosus*).
A, beetles. (Natural size.)

TREATMENT.

Nothing can be done to trees badly attacked. They had best be left as "traps," and cut down and burned during the winter, or at any time when we know the beetles are not in flight.

This must be done not later than the first week in June, and is best done in March, when no beetles have escaped as far as personal observations go. If the destruction at the time all the insects are in the trees was carried out, the loss these little beetles occasion would be much lessened. It is especially important to have old stumps, dying trees, etc., destroyed. Great numbers of these were noticed in 1906 in Worcestershire, and as long as they remain in this useless, slovenly way, so long will young, sound trees, of good fruit-growers in the neighbourhood be damaged; for in flight time these beetles are very strong on the wing, and can fly considerable distances.

The dressing of fruit trees to keep off this pest has been frequently referred to.

Fletcher (3) mentions that in Canada trees are dressed with soft soap and carbolic acid up to the point where the main branches have their origin in cases of *Xyleborus* attack.

Forbes (4) points out that the application of soap and soda poisoned with arsenic, now used against ordinary borers, if applied to the larger branches as well as the trunk, might be found to check sufficiently the mischief done by this bark beetle.

In this country it is the small branches and twigs that are attacked as much as the trunk, and thus dressing is of less value—it will protect the trunk, but merely drives the beetles higher up, and dressing the whole of a large tree is, of course, very difficult.

There need be no great harm done if the diseased trees are destroyed at once to stop the beetles from spreading, and if some persuasive steps could be taken to get negligent people to destroy the old breeding grounds of this beetle. A pig with swine fever is killed by compulsion, but it does not seem worth while to compel breeding grounds of fruit pests to be destroyed. So long as the many fruit-growers, who excel those of any other country, allow this to go on, so long will they lose trees by this and other pests, and their energies and money will be largely wasted.

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BEETLES IN FRUIT BLOSSOM.

Many inquiries have been received concerning the economy of beetles found in the open apple and other fruit blossom.*

The most important species sent have been the Pea and Bean Weevil (*Sitones lineata*), the Mustard Blossom Beetle (*Meligethes oeneus*) and the Flea Beetles (*Phyllotreta nemorum* and *Haltica oleracea*).

Mr. Bickham of Ledbury sent Pea and Bean Weevils in April 1906, stating that they were very numerous in parts of Herefordshire, in the crowns of strawberry plants, and later they were noticed in the blossom. Both at Mr. Bickham's and at Mr. Riley's, Putley Court, numbers could be found in the crowns of almost every strawberry plant. No damage has been noticed in the blossom or leaf of strawberries, when they have been present, as they often are in the early part of the year. It appears that they merely go there for shelter. They have been sent from the same county and Kent from apple blossom, but although occurring in numbers no damage could be traced to them.

From Herefordshire I also received inquiries about *Meligethes* in apple blossom. One correspondent wrote stating that they occurred in thousands in his plantations. The beetles are described as crawling right down to the base of the pistil and stamens. The grower stated "that some of the pistils had been killed by frost some days ago, so I cannot tell whether all the blossoms which show the black pistil have been killed by the frost or by the beetles. So far as I can see, by looking down into the blossoms without disturbing them, the beetles appear to be merely feasting on the sweet liquid at the base of the pistil. I noticed the beetles in another plantation in the apple blossoms, but not to the same extent."

A series of observations were made at Wye concerning this question, as these small beetles were also abundant in apple blossom in that neighbourhood. The blossom of almost all varieties was

* Report on Economic Zoology for the year ending April 1st, 1907, p. 84.
F. V. Theobald, etc.

noticed to be much bitten in small holes and it was thought that the *Meligethes* were the cause.

Numbers were collected and kept in cages with a supply of open and opening blossom tufts, but in no case was any harm caused by the beetles. Similar observations were made in the College orchards and the same conclusion arrived at. The beetles were feeding upon both the pollen and the liquid. It is thus possible that they may cause some slight loss by feeding on the former, but at the same time they fly from blossom to blossom and, as was observed, carry the pollen with them, and so do as much good in fertilisation as the bees.

It was feared that they might work in the same way as this species does in mustard and other cruciferous plants, but such has not proved to be the case.

The Mustard Blossom Beetle (*Meligethes aeneus*) lays its eggs in the blossom buds of mustard, and the larvae which hatch from them feed upon the various parts of the flowers, especially at the base. They also attack the flower stalks and even the young pods, and when mature fall to the ground to pupate, just under the soil. Miss Ormerod also noticed that the beetles fed entirely on the pollen of plants of the cabbage kind.

The maggots feed at the base of the blossom of cruciferae, but prolonged search did not reveal any in the apple blossom.

The larvae of these beetles are to be found in June and early July. The pupal stage is entered about ten days after the larvae burrow into the soil. An earthen cell is formed by the larvae in which to pupate.

Besides *Meligethes aeneus*, Mr. C. O. Waterhouse kindly named for me others found in fewer numbers in the apple blossom, including *M. picipes*.

The first-named species (*aeneus*) is $\frac{1}{12}$ inch long and of a dull deep greenish hue. Its eggs are long, bluntly cylindrical and very transparent. They take four or five (Miss Ormerod) to eight days to hatch.

The maggots reach about $\frac{1}{12}$ inch in length, they are yellowish-white in colour, with a few dull indistinct spots, three pairs of jointed legs in front and an anal proleg; the head is dark and large.

The small holes eaten in the blossoms on apple were traced at Wye to the Flea Beetles (*Haltica oleracea* and *Phyllotreta nemorum*).

THE TWIG CUTTER.

(*Rhynchites caeruleus*, De Geer.)

This twig-cutting weevil is undoubtedly the chief culprit in cutting off the shoots of apple bushes, at least all specimens sent me and all those that I have watched have belonged to this species, kindly identified for me by Mr. Gimmingham of the S. E. Agriculture College.

It was first brought to my notice in 1899 by Mr. F. Smith of Loddington, who pointed out the habits of this "small, shiny, blue beetle" cutting off the shoots of the apple in his plantations.

Many inquiries have reached me from Kent concerning this weevil. In 1907 it was very abundant in my garden, where it did a great amount of harm to some young trees and also attacked others 15 to 20 years old.

The beetles (Fig. 96) are about $\frac{1}{8}$ inch long, exclusive of the snout, some ranging up to $\frac{1}{6}$ inch, they are deep blue, shiny, clothed with long, upright fuscous pubescence, antennæ, legs and rostrum black or blue black, femora deep blue; thorax longer than broad, with the sides almost straight, coarsely punctured; elytra with deep punctured striæ, interstices flat with fine punctures, scutellary striae wanting.

They appear in spring and may be found crawling over the trees and seem to feed upon the leaves, doing, however, little or no harm.

After being fertilised the females commence to deposit their eggs, this they do in the shoots when quite soft. A small hole is first bored by means of the proboscis from two to four inches from the tip of the shoot. In this small hole the female deposits a single oblong



[A. V. D. Rintoul.]

FIG. 95.—APPLE SHOOT CUT BY TWIG CUTTER.
(*Rhynchites caeruleus*.)

oval yellow egg. I have never found more than one in each shoot, but according to Kollar this or an allied species (*interpunctatus*) may place two eggs. After doing this the female with energy cuts off the shoot just below where the egg has been laid and it falls to the ground. In many cases kept under observation the top was seen to



FIG. 96.

THE APPLE TWIG CUTTER
(*Rhynchites ceruleus*).
($\times 3$.)

be cut only partly through, so that the shoot hangs down as shown in the photograph (Fig. 95). Soon the damaged shoot flags and later falls with the contained maggot or egg to the ground. The curious cut off and blunt shoots are very characteristic on attacked trees. The yellow ovum hatches in a few days, and the white footless maggot feeds upon the pith and in a month it reaches maturity. It then leaves its shelter and pupates in the soil, in a small earthen cell. In dry weather large numbers of them doubtless die, owing to the shoot and pith rapidly shrivelling

THE ALLIED TWIG CUTTERS.

(*Rhynchites interpunctatus*. Steph.)

This small weevil seems to work in a similar way to the previous one. Kollar gives a general description of its working in Germany. Although widely distributed in Britain there are no records of its damaging fruit trees.

It is steel blue in colour, the thorax finely punctured and slightly pubescent; elytra with punctate striae, the interstices also furnished with a single row of punctures; antennæ, rostrum and legs deep steel blue; length $\frac{1}{10}$ inch. On the Continent it seems to do serious damage at times.

Rhynchites pauxillus. Germ.

Allied to the two former, but may be told from *interpunctatus* by having a deep central furrow on the thorax and from *ceruleus* by the presence of scutellary striae.

It is recorded by Canon Fowler on various *Pomaceæ*, especially the medlar.

THE LEAF WEEVILS.

(*Phyllobius maculicornis*, Germ., and *P. oblongus*, Linn. etc.)

The Leaf Weevils are found on all kinds of vegetation, and several species are common to not only many kinds of fruit but also to various forest trees and shrubs.

The colours of the weevils are usually shades of brown, clay colour or metallic greens, some almost golden-green.

Two species are more prominent than others on fruit trees and bushes, namely, the Green Leaf Weevil (*Phyllobius maculicornis*, Germ.) and the Oblong Leaf Weevil (*P. oblongus*, Linn.).

The former species we find feeding on apple, pear, cherry, plum and especially nuts, and it also occurs on oak, hawthorn, sloe and maple. In colour it is brown, clothed with bright green, bluish-



1



2



3

FIG. 97.—LEAF WEEVILS (*Phyllobius*).

1, *Phyllobius maculicornis*. 2, *P. oblongus*. 3, *P. uniformis*.
($\times 3.$)

green or golden-yellow scales; slightly hairy; antennae reddish, with black, club-like apices; legs black and brown. In length they vary from $\frac{1}{6}$ to nearly $\frac{1}{3}$ inch.

The Oblong Leaf Weevil (*Phyllobius oblongus*, Linn.) is about the same size as the former. The body is black, the elytra covered with dull brown scales, with a reddish tinge or pale grey, the borders dark, almost black, head and thorax covered with grey pubescence and also the elytra; legs brown or yellowish.

The damage these beetles do is twofold: first, they nibble the young opening buds; and then, later, they attack the leaves.

Several correspondents have written complaining of them in apple blossom, and it seems from some I kept under observation that they gnaw the parts of the blossom and stop the fructification.

Both species occur about the same time, in the beginning of May, and continue until the end of June.

They are very active in bright warm weather, but on dull days they remain stationary on the leaves and then can readily be shaken down.

They frequently occur in very large numbers in Kent and Sussex, and may be found in most other parts of Britain. One peculiarity I have noticed, and that is, that in certain years they do harm, and that in others, although occurring in great quantities, they seem to cause no apparent damage.

The females lay their eggs in the ground and the maggots feed upon roots of various kinds of plants during the winter. The larvae are white, footless and curved in form, slightly hairy and with a brown horny head. In spring they change to pupae in the earth and the beetles emerge in May.

Ormerod (1) says that grafted plants in nurseries are noted as especially liable to attack. This I have observed during 1908, when considerable damage was done by them in this way in several parts of Kent. Amongst all weevils this form of attack is of common occurrence.

PREVENTION AND REMEDIES.

The beetles may be collected on dull days by jarring them off the trees, and this is certainly worth doing where they occur in very large numbers. It is doubtful, anyhow, with our present amount of information, if any treatment for the maggots would be of any avail. On the other hand, I have found that where nuts have been sprayed for caterpillars with arsenate of lead that the beetles were killed, just as Mr. Fred Smith found to be the case with the Nut Weevil.

When young grafted stock is affected, it has been found of use to tie grease bands around them and to then jar the beetles off, numbers when crawling back being caught.

REFERENCE.

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OTHER BEETLES FEEDING UPON THE APPLE.

- Rhynchites bacchus*, L.
Rhynchites cupreus, L.
Obrium cantharinum, L.
Pogonocherus bidentatus, Thoms.
Otiorhynchus picipes, F.
Otiorhynchus sulcatus, F.
Otiorhynchus tenebricosus, F.
Otiorhynchus fuscipes, F.

RHYNCHITES BACCHUS, L. (Purple Apple Weevil).—This weevil is purplish-coppery on the upper surface, covered with long, reddish-brown pubescence. The proboscis is long, curved, carinated at the base, and dark blue in colour; antennae black; elytra broadened at the base, with irregular rows of deep punctures closely rugose between; legs coppery, tarsi black. Length $\frac{1}{4}$ to $\frac{1}{2}$ inch.

This is a rare species in England, according to Canon Fowler.* This authority records it on the young shoots of the vine, as well as apple. Kollar, on the other hand, expressly states that he has never found it on the vine, but a distinct species. I have taken this species in May upon apple trees in Kent. It is stated to breed at midsummer and soon after it places its eggs in the apples by boring holes into them with its rostrum, and there placing three or four eggs. The larva is white and footless, with a black head, and comes from the egg, according to Kollar, in a few days. It then burrows to the core, and on to the outside, very similarly to the Codling Maggot (*C. pomonella*). Maturity is reached in four weeks. Pupation takes place in the ground, the pupa remaining there until the following spring. Some weevil larvae were sent me in 1886 from Kent in the interior of apples; whether they belonged to this species I cannot say. The larvae answered to the description given by Kollar.

R. CUPREUS, L. (the Copper-coloured Weevil).—Purple-aeneous, dull, finely pubescent; ventrally metallic-black; head long and thickly punctured; rostrum stout, sulcate at base. Thorax punctate, with smooth central line; scutellum large. Elytra with deeply punctate striae; legs brassy-black, tarsi black; length $\frac{1}{5}$ inch. Recorded by Canon Fowler on apple blossoms. It is also recorded by Kollar in the fruit of the plum. The beetle lays a single egg in the plum, and then cuts the plum off, so that it falls to the ground with the enclosed egg, or else cuts the petiole nearly through, and lets the

* 'British Coleoptera,' vol. V., pp. 123, 124.

wind break it off. The description of an attack very similar to this by a weevil was sent me some years ago from Surrey, and as the imagines are found on apple, it is possible it may have been due to them.

OBRIUM CANTHARINUM, L. (*ferrugineum*, F.).—This species is found in the bark of apple trees, but is rare. It is an elegant beetle about $\frac{3}{5}$ inch in length; it is elongate, of a pale reddish-brown colour, with dark brown antennæ and legs; eyes very large and black, wider than the thorax; antennæ much longer than body; elytra depressed and punctured. According to Dr. Power, who bred them from aspen, the beetles kept on coming out from the same piece of wood for three years.

POGONOCLERUS BIDENTATUS, Thoms.—Also found under the bark of decaying apple and pear trees. This is a fuscous beetle, variegated with white, and lighter or darker brown pubescence; base of antennal joints white; elytra narrowed at the apex, which is broad and bidentate, scutellum clothed with white pubescence; at the base of the elytra is a broad band of white pubescence, a little cloud at the shoulder, and in the middle, extending from the base over nearly half their surface, between this and the apex, are several black spots of hair; legs dark, variegated with red, more or less pubescent.

According to Canon Fowler, from whose work the description of the beetle is given, it is local, but not uncommon in many districts. I have never met with the species myself, and do not think it has ever occasioned any harm.

THE APPLE SAWFLY.

(*Hoplocampa testudinea*. Klug.)

The Apple Sawfly is very persistent in some districts of Britain. To some extent its method of working resembles that of the Codling Moth, so much so that it has often been confused with it. It has been known as injurious since 1847, when Westwood (1) described an attack from personal observations. The insect was first described by Klug (Berl. Mag. viii. 60.30). Ormerod refers to it in her little handbook on Orchard and Bush Fruit Pests (2). The larvae can at once be told from those of the Codling Moth by the presence of six

pairs of sucker feet, exclusive of the anal pair, and by their dull creamy-white appearance.

The damage to the interior of the fruits is very different from that of the Codling Moth. The sawfly larvae eat out large cavities in the centre of the apple, and there is always a circular opening to the exterior even when the larvae are quite small. The damage in the young fruit checks the growth and it soon falls, the larva entering fresh fruitlets; when more mature fruit is attacked the whole of the interior is eaten out (Fig. 98) and a large black wet cavity is formed. One or more larvae may be found in the same



[F. Edenden.]

FIG. 98.—APPLES EATEN OUT BY APPLE SAWFLY.

The one on right shows exit hole of larva.

apple. The larvae enter the fruit from the first infected fruitlet at any part of its surface, very frequently they eat along the surface first and then enter or they may pass on to the next fruitlet. The mark shown in Fig. 99 is due to this habit of the sawfly larva, and much disfigures and often deforms the apples.

It is a widely distributed insect, but only locally common. So far it has been recorded from Surrey, Kent, Bedfordshire, Cambridgeshire, Nottinghamshire, Lincolnshire, Middlesex, Huntingdonshire, Herefordshire, and Lancashire, Manchester. Westwood (1) described an attack at Hammersmith.

LIFE-HISTORY AND HABITS.

The female sawfly is reddish-yellow with a black patch on the head, and another on the thorax; the dorsum of the abdomen black; the head and mid division of the thorax minutely punctured; the reddish-yellow antennae are dusky in the middle. The legs yellowish-red; wings transparent, somewhat iridescent with brown rims and dark stigma, except at its end nearest the apex of the wing, where it is yellow. The female is from $\frac{1}{4}$ to nearly $\frac{1}{3}$ inch long, the male very slightly smaller.

The adult appears in spring about the time the apple blossom is



[F. Edenden.]

FIG. 90.—APPLE SHOWING SCAR FORMED BY APPLE SAWFLY ON YOUNG FRUIT,
WHICH THE MAGGOT FAILED TO ENTER..

bursting. The date varies from the end of April until the middle of May.

The females may be easily taken on bright days sitting on the blossom, where they lay their eggs. The ova are laid down below the calyx, seldom more than one egg to each blossom, but several larvae have been found in one fruitlet. It appears that they lay their ova between 9 and 2 o'clock, and then on bright days only.

The egg stage varies in length, it may take eight days or it may be two weeks in incubating.

Under certain conditions a second brood may appear, but such seems to be very unusual.

The larvae are creamy-white, grub-like creatures, with a dark



FIG. 100.—SAW OF A FEMALE SAWFLY.
(Greatly enlarged.)

brown head and a double black chitinous plate on the upper surface of the anal segment. When mature they reach $\frac{1}{2}$ inch in length. On the first three segments are six jointed legs, on the fifth to the tenth are pairs of sucker feet, and on the last segment another pair of sucker feet.

These larvae burrow into the fruitlets and eat out large cavities, often attacking apples when they are no larger than cob nuts. Each of these large irregular chambers communicates with the exterior by a small round hole which is usually noticed on the side or near the eye of the apple. Out of this opening one frequently finds "frass" and much moisture exuding.

Attacked fruitlets can be seen on a tree long before they fall. The larvae may be found of all sizes in June and early July. Possibly two broods overlap (3). The length of larval life seems to vary, some mature in four weeks, others take five weeks or more. If the fruitlet is destroyed before the larva is mature it moves to another. When attack is early, and the fruitlets small, five or more may be damaged by each larva. When mature, the larvae



{F. Edenden.
FIG. 101.—THE APPLE SAWFLY.
(Natural size and enlarged.)

fall to the ground and bury themselves in it from one up to four inches deep.

The pupa is encased in a small dull yellowish cocoon coated with grains of earth outside. Larvæ which were noticed to fall at the end of May had pupated by the 13th of June, and flies appeared on the 7th of July. This was the second generation, and these were found to attack larger apples in July and August. Larvæ were once found on the 3rd of September. This is evidently very unusual. Very few are found after mid July and most seem to pupate well before then.

Winter is passed in the larval stage in the soil, pupation not taking place until the spring.

It is said by some observers that the larvæ fall with the fruit, but by far the larger number have been found to fall from it.

One fact noticed in 1906 and 1907 was, that many of the attacked fruitlets hold on to the trees through the winter, being readily told from the mummified fruits of *Monilia* by the round holes in them.

PREVENTION AND TREATMENT.

Little can be done when fruit is once struck, but as we know they move from apple to apple, hand-picking the infested fruitlets is worth doing when we see the attack. Spraying with arsenate of lead paste to kill the larvæ as they move from fruitlet to fruitlet has proved of no avail.

Some good has resulted by well working the land in spring and giving a dressing of kainit, but it cannot be called a definite preventive.

The best results have been obtained by injecting bisulphide of carbon into the soil at the rate of 4 oz. to each tree in eight injections by means of the Vermorel Injector.

Removal of surface soil is, of course, successful, and where a few trees only are invaded is worth doing, but it could not be done in a plantation well attacked. Possibly the sawflies may be trapped by sweet baits, but until much further experiments have been conducted all we can rely on is hand-picking and destruction of the fruitlets in early attacks. Further trials of bisulphide injections should be made. Fortunately this pest seems to work only on bush trees.

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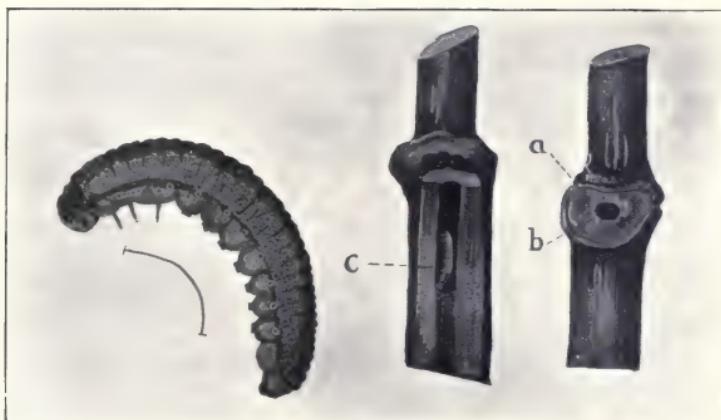
- (1) *Westwood, J. O.* Gardeners' Chronicle, p. 851 (1848).
- (2) *Ormerod, E. A.* 'Handbook of Insects Injurious to Orchard and Bush Fruits,' p. 35 (1898).
- (3) *Theobald, F. V.* The Apple Sawfly, Board of Agriculture Journal, p. 183 (Sept. 1901).

AN *EMPHYTUS* SP.? ATTACKING THE APPLE.

A single case only of this insect attack has been brought to my notice, and I can find no reference to it in literature.* A well-known grower, Mr. H. F. Getting of Ashfield Park, Ross, wrote in November: "I was startled to find a number of my young apple trees with a round hole in the top of *last* year's growth (*i.e.*, where branches were pruned to). On examination I found that green caterpillars were doing the damage. This is quite new to me, and I am afraid may be a serious pest."

The culprit proved to be one of the Sawflies belonging to the genus *Emphytus*.

The larvae enter the pith cavities to pupate, and in doing so they



[F. V. Theobald.
FIG. 102.—LARVA OF THE APPLE EMPHYTUS (*Emphytus* sp.?).

c, larva *in situ*; *b*, entrance of tunnel; *a*, excrement.

may be the cause of much damage, as many of them seemed to bore down below the point of origin of the side shoot, and this not only weakens its growth, but may destroy it entirely. Mr. Getting noticed that they preferred to attack the main shoot, doubtless owing to the pith cavity being larger. Their presence may easily be detected by the "frass" and granular pith thrown out, which collects on the pruned surface as a fine dust (Fig. 102 *a*).

Mr. Getting's further observations are as follows: "After it has made the hole sufficiently deep, it turns round with its head towards

* The following account is taken from my Report on Economic Zoology for the year ending April 1st, 1905.

the opening and then commences to make at the top of the hole (or $\frac{1}{16}$ to $\frac{1}{8}$ inch below the top) a covering of the dust, and apparently some liquid. I also found one crawling along a branch."

The genus *Emphytus*, to which this pest belongs, has thirteen representatives in Britain. The larvae are all somewhat similar, being greenish on the back, paler at the sides, and sometimes covered with a white powder. No definite cocoon is formed. Most bore, as described above, into the stems of plants to pupate. For this purpose rosaceous plants are mostly sought after. A few, however, are found on the oak, birch and willow, and on *Geranium robertianum*.

I think there is no doubt that the species attacking the apple in Herefordshire was the *Emphytus carpini* of Hartig, as the larva most closely approaches the description of that insect.

The mature larvæ (Fig. 102) I examined varied from $\frac{1}{2}$ inch to a little more in length. In colour the dorsum varied from rich deep apple-green to dull olive-green. The sides and venter much paler, varying from dull greenish-white to pale yellowish-green, a few pale spines on the back of the segments; the spiracles black with a pale area around them. Head, deep brown to almost black above, paler beneath. The true legs pale, with deep brown apices; the seven pairs of prolegs the same colour as the venter.

When taken from their chambers, the larvæ curl themselves up in the characteristic manner of their genus.

The last two or three abdominal segments are paler than the rest, but darken to the same colour during the winter. The young larva is said to be pale, dirty olive-green above, and the posterior segments are seen to be clearer than the rest.

They remained in the larval stage until the end of March, and then changed into pallid pupæ.

Emphytus carpini is a common English and Scotch insect. The larvæ feed in shady places on *Geranium robertianum*, also on the mountain ash (*Sorbus aucuparia*) and hawthorn (2).

There are two generations: one in July, August and September, which feed on the radical leaves; the second in October and November, and which feed on the other leaves, eating them down to the thick mid rib. They feed on the lower surface.

The adult fly is black and shiny, the legs mostly white, but there is black on the middle of the femora, on the apex of the hind tibiae; the hind tarsi and the fore and mid tarsi dusky. Length $\frac{1}{4}$ inch.

The only other species it might be is *Emphytus cinctus*, Linneus, whose larvæ feed on the common rose, eating the leaves along the edges. Those from the apple differ, however, in not having the

thoracic region thickened as we notice in the rose feeder. The latter pupate in the rose stems and occur in larval form from July to October.

Since the above Report was drawn up (2), the *E. cinctus* has been compared with the apple species and found to be distinct.

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W A S P S.

(*Vespidae*.)

Wasps are a general cause of annoyance. They attack all kinds of fruits and spoil them. The soft plums are no more attacked than the hardest cooking apples. The loss in the former is perhaps the greatest, but the manner of attack in the latter is the most interesting. In 1887, 1892 and 1893, and in 1900, and again in 1903, quite a number of complaints were made about wasp damage to apples. From near St. Neots, Huntingdonshire, Mr. Murfin sent, in 1900, a number of apples which had been completely hollowed out by wasps; the skins had dried and remained on the trees. These specimens are to be seen in the Gallery of Economic Zoology in the British Museum, South Kensington, which has never been completed owing to lack of funds. Two species of wasps are the main culprits on fruit, namely, the Common Wasp (*Vespa vulgaris*) and the Tree Wasp (*Vespa sylvestris*), and two others I have found now and again injuring fruits, namely, *Vespa germanica* and *Vespa rufa*. In Scotland a tree wasp (*Vespa norwegica*, Fab.) is also somewhat harmful.

Possibly others of our seven British wasps may do harm, but no records have been sent me and it is extremely unlikely that one, the Hornet (*Vespa crabro*), attacks fruit. The life-history of wasps can be found in any book on Natural History, so need not be referred to here.

DESTRUCTION OF WASPS.

This again scarcely needs to be mentioned. Any labourer or gardener will find the nest on the ground, and each has his special

way of getting rid of them. Some use sulphur, some gunpowder, and then dig them out; perhaps these are the best ways. Experience has shown that cyanide of potassium is no better than the old country methods.

One point only may perhaps be worth drawing attention to, and that is, that we must keep a look-out for the so-called arboreal builders. The *Vespa sylvestris* and *V. norwegica* form their beautiful hanging nests in trees, shrubs, even in kale-pots; these must be sought for and destroyed with the ground-wasp nests. The best plan seems to be to mark them in daytime and burn them down with a paraffin torch at night.

Wasps do much harm in vineeries; there they may be kept out by seeing all openings and opened windows are covered with wasp netting. This may be improved on in vineeries by using muslin, so as to exclude the grape fly at the same time.

It is certainly advantageous, by offering small rewards, to have all the queen wasps destroyed early in the year.

THE APPLE APHIDES.

(*Aphis pomi*, De Geer, *Aphis sorbi*, Kaltenbach, *Aphis fitchii*, Sanderson.)

At least three true aphides are abundant on the apple in Great Britain, damaging the foliage, also deforming the shoots and spoiling the fruit.* A bad attack took place during 1904 in Britain of these Apple Aphides. Scarcely a fruit-growing district was free from these pests, and in many orchards the leaves were so hopelessly curled that washing was of no avail whatever. Feeding not only on the leaves and blossoms, but on the young shoots, they distort them to a serious extent, as shown in the photograph (Fig. 104). In one instance on two trees kept under observation, it was found that the aphis lessened the growth of certain shoots by 70 per cent., and a few shoots died right back (Fig. 103).

The great importance of these insects led me to investigate their life-history, which has not been done *de novo* in this country. The result (1) has been so far satisfactory in that it has shown when these fruit pests are most vulnerable to attack and when we can follow that excellent adage: "Prevention is better than cure." What

* The Apple Aphides have been wrongly treated by Ormerod, Whitehead, etc., as a single species, *Aphis mali*, Fabricius.

physiological changes take place in the attacked shoots and leaves have never been investigated. Why the leaves should, as is frequently noticed, hang on the trees instead of falling normally, has not been explained. This is a very marked character in trees that have been infested with *Aphis pomi*, De Geer.



[F. Edenden.

FIG. 103.—APPLE SHOOT DESTROYED BY *Aphis pomi*.

With a few exceptions the chief aphides on apple trees have been seen to belong to three species, *Aphis pomi*, De Geer,* *Aphis*

* This has usually been known as *Aphis mali*, Fabricius 1775, but De Geer had previously described it as *Aphis pomi* in 1773.

fitchii, Sanderson, and *Aphis sorbi*, Kaltenbach. The exceptions were in a tree where a few *Aphis pruni* had taken up their abode, and a few on which another doubtful species occurred.



[F. Edenden.

FIG. 104.—DAMAGE TO APPLE SHOOTS BY APHIS.

The three left-hand shoots damaged by *Aphis pomi*, the right-hand one normal.

Casual specimens of other kinds may occur, but they do not breed on the apple.

The Permanent Apple Aphid.

(Aphis pomii, De Geer = A. mali, Fabricius.)

The LIFE-HISTORY is as follows.

The eggs hatch late in April. The eggs are elongated, oval, shiny black bodies placed sometimes at the base of the buds or the axils of the old leaves, but usually on the shoots. Many occur together, usually large numbers on one shoot. They are undoubtedly mostly laid on the young shoots amongst the hairs (Fig. 105).

The larvae or lice are very sluggish at first, deep green or yellow. They grow but slowly, and are ready by the time the leaves are completely open to commence attack. The larva casts its skin three times, and becomes the apterous viviparous female. This female shelters under the leaves, which she punctures, and the result is the punctured area curls up.

This first female or "stem mother" is greenish to greenish-grey, much mottled with yellowish, globular in form, and has a small spine on each edge of the abdominal segments, and long, black, straight, tapering cornicles; the antennae are yellowish basally, dark apically; the legs are yellowish-green, the knees, tips of the tibiae and tarsi dark brown. Frequently I have noticed a mealy coating over this so-called "mother-queen." She soon commences to produce living young, which mature rapidly in warm, dry weather, and cause the leaves to curl up with remarkable rapidity.

The progeny from the "mother-queen," according to Buckton (2), have a variety of colours, "as bright green, yellowish, ferruginous red or brown." Frequent observations on this aphid in Kent, Cambridgeshire, Surrey and Huntingdonshire, during the last twenty years by myself, only resulted in finding a dull reddish variety, which appeared to be a dimorphic form. Recent observations have, however, shown this to be incorrect, more than one species occurring on the same tree. The true *Aphis pomii* of De Geer is always green or bright yellowish-green. The young from the "stem mother," which are produced alive, are also green with two dark spots on the head and dusky and green legs.



FIG. 105.—OVA OF APPLE APHIS (*Aphis pomii*).
{F. Edenden.

The mature viviparous females into which the lice turn, have pale yellowish-green abdomen with darker green lines and sides,

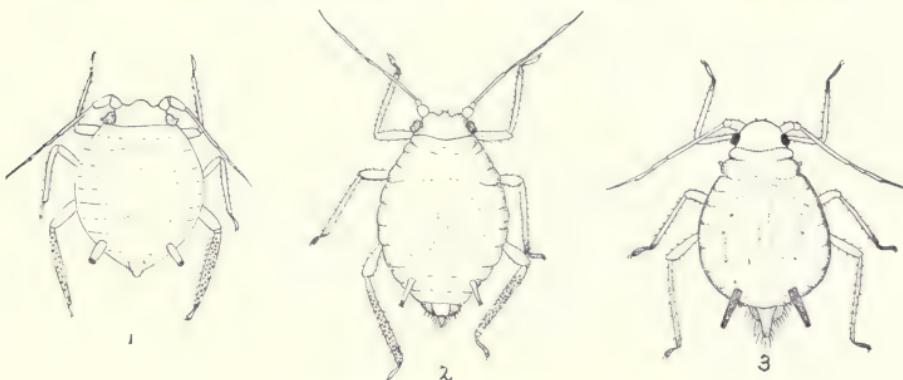


FIG. 105.—APPLE APHIDES.

1. *Aphis fitchii*. 2. *A. sorbi*. 3. *A. pomi*. All oviparous females.
(Partly after Sanderson.)

cornicles long and dark, sometimes a faint yellow spot at the base of each cornicle and an indistinct band connecting them.

These lice and apterous viviparous females curl up the leaves, and feed not only upon them, but also upon the young and tender shoots. The majority are found, not only covered with a grey meal, but also with numerous oil globules interspersed between them.

In July and August, many of the lice turn to pupæ. The pupæ are greenish-yellow, some having darker green stripes, and the wing buds and the cornicles yellow with dark apices, and, like the apterous females and lice, are covered with a mealy powder.

From these pupæ winged viviparous females appear in July and August. A few may be seen some years in June.

The winged female has a deep greenish-brown head, the thorax brownish-black, prothorax paler; the abdomen deep green with three black spots on each side. The antennæ yellowish-brown with dusky joints, and dark cornicles. The legs pale green with dusky tarsi, and tips of tibiæ and knees.



[F. E.]

FIG. 107.—*Aphis sorbi*. OVIPAROUS FEMALE. YOUNG STAGE.

These winged females are viviparous, and fly or are carried by the wind from tree to tree and orchard to orchard. These set up

fresh colonies, and so the increase goes on until late in the autumn. During this time, many leaves dry up and their curled form encloses many of the dolphins, which are apparently thus killed.

Late in the autumn a progeny of wingless males and females occur. The female is very small, often little more than $1\frac{1}{2}$ mm. long, varying in colour from dull yellowish-green to green, head slightly brownish, with two dark spots; antennæ pale at the base, dusky apically, legs pale green, except the apical portion of the tibiae, the tarsi and knees, which are brown; cornicles black, straight, tapering; genitalia dusky with two dark spots in front, some show paler sides and are darker green according to their age. They are closely attached to the underside of the apple leaves. Most occur close against a rib or vein of the leaf. At the same time small wingless males appear. These are often not more than one-fifth the size of the autumn oviparous females. Unlike most male aphides, it has a longish proboscis, nearly reaching to the second abdominal segment and which is black in colour; it has rather long dark brown legs. In colour, the male varies from yellowish-brown to dull yellowish, with dark head, long blackish antennæ; cornicles and apex of body black, the former straight. These sexual forms were noticed last year first on the 27th of October, and on until the 7th of December. The females commenced to deposit eggs early in November and continued to do so for over a month. Most placed their black ova on the shoots, a few at the base of buds, and the axils of twigs. As many as three hundred eggs may be found on one shoot. The ova remain all the winter, and can then easily be seen by their shiny shells. Great numbers of these eggs shrivel up. These are infertile ones. It is these sterile ova that are thought to have been killed by various winter washes. This species, in company with *Aphis sorbi*, curls the leaves, but does not attack the blossom.

This aphid occurs in Ireland as well as England, Carpenter (8), recording it from County Tyrone.



[F. E.]

FIG. 108.—YOUNG APHIDES JUST HATCHED, FEEDING ON APPLE BUD.

The Rosy Apple Aphis.

(Aphis sorbi. Kaltenbach.)

This species is often found with *Aphis pomi*, and is frequently confused with it even by authorities such as Buckton, whose figure of the apterous viviparous *Aphis mali* (*pomi*) is really this insect. It works in a similar way to the former, but seems to curl up the leaves more tightly, and to give them a blistered appearance, the attacked portions often having a rosy and pallid hue. Unlike *A. pomi*,

it does not pass all the year on the apple, for in June and early July it migrates from the apples and comes back again in the autumn. To what plant they migrate is not yet known. They have been found on the hawthorn (*Crataegus oxyacantha*), the pear and on *Sorbus aucuparia*, *Sorbus domesticus* and *Sorbus torminalis*. I have frequently found it on the hawthorn, but at the same time as when observed on the apple.



[F. Edenden.]

FIG. 100.—“STEM MOTHER” (VIVIPAROUS FEMALE) OF *Aphis sorbi*, KALT.
(Greatly enlarged.)

In colour it is subject to much variation, unlike *A. pomi* and *A. fitchii*.

The “stem mother,” or apterous viviparous female, is at first mottled with green and yellow, laterally bluish, with a rusty tinge around the bases of the cornicles, but she gradually becomes dull bluish to black or slaty-grey, or purple, covered with meal; in form this stage is globular. The larvae vary but are usually yellowish-green, mottled with yellowish, head pale, cornicles blackish and legs blackish, becoming bluish at the sides with pale yellowish bases. The apterous viviparous females are smaller than the stem mother, rusty red to almost pink, with brown marks on the sides of the abdomen and on the thorax; tapering cornicles, dusky at the apices, yellow at their base; later they become dusky purplish-black, dusky red basally and covered with white meal. The pupa varies from

yellowish-red to pink, wing buds paler with dusky apices, also mealy.

Winged viviparous female with black thorax, yellowish-red abdomen; cornicles black; legs with pale bases and tibiae and also pale around the base of the cornicles. The autumn form has deep black head and thorax, reddish-brown abdomen with a dusky central area and a dark band between the cornicles. Structurally this autumn form differs from the spring in having no tubercles on the head, and on the seventh and eighth abdominal segments.

The *oviparous female* is pale lemon-yellow with dusky head, eyes, antennæ and tarsi. The *male* is winged, and has a greenish abdomen marked with black and a dark thorax and narrower than the winged female. This species hatches about the same time as *A. fitchii*, that is, somewhat earlier than *A. pomi*. Two or three broods occur, and then they leave the apple, flying apparently to a new food plant. They disappear during the last week in June until the second week in July. The autumn winged females return in September and October and produce a generation of winged males and wingless oviparous females. The latter lay their oval, shiny black eggs either on the spurs, axils of buds, shoots, or on the trunks of the trees. Most, if not all, the aphis eggs found on the trunks belong to this species.

In Cambridge some years ago this was the only form I found, and was considered to be the *Aphis mali*, i.e., *A. pomi*, De Geer. In Kent it is common, and during 1906 did no little harm to the young leaves.

The Blossom and Stem Aphis.

(*Aphis fitchii*. Sanderson.)

This also has been taken to be the common *Aphis pomi* by Ormerod (3), Whitehead (4), and others in Britain. Yet in 1829, Joshua Major (5) clearly pointed out this species as different from the Leaf Curling Aphis. The specific definition of this Blossom Aphis was made by Mr. Dwight Sanderson (6) whose work made me examine the Apple Aphides of this country more closely.

This species I found in Kent in all the localities where it was sought for, but did not seem to be more destructive than the two



[F. E.
FIG. 110.—*Aphis sorbi*. LARVA
FROM VIVIPAROUS FEMALE.
(Greatly enlarged.)

former. It is also common in Worcestershire, Herefordshire, Devonshire, and most parts where apples are grown. It occurs earlier than



[F. Edenden.]

FIG. 111.—*Aphis fitchii*. NYMPH, SHOWING EXTRUDING YOUNG.
(Greatly enlarged.)



[F. Edenden.]

FIG. 112.—*Aphis fitchii* (VIVIPAROUS FEMALE), SHOWING LARVAL ICHNEUMON WITHIN.

either of the former, the young coming from the eggs in April, and feeding upon the developing buds for some time. Later they attack the blossom and were then noticed to do much harm. In 1907 the eggs commenced to hatch on the 24th of March. Sanderson found in America that the young became full grown in seven to nine days. Those I kept under observation took twelve days before reaching maturity. Migration takes place in the beginning of June and continues to the end of the month. From this time until October,

the apple is free from this pest. From the 12th of September winged forms were observed to come back to the apple and egg-laying continued until the middle of November. These oviparous females deposit a few eggs, mainly in the axils of the buds and on the spurs. Just as was noticed by Walker, winged viviparous and winged oviparous females occur together on the same leaves in the autumn. Attacked blossom becomes



[F. E.]

FIG. 113.—OVUM OF *Aphis fitchii* LAID IN BRANCH CREVICE.
(Greatly enlarged.)

browned and dies; leaves are also attacked, but this species does not seem to curl the leaves in the same way the other two species

do. Young blossom tufts are most attacked, and are seriously damaged.

The *apterous viriparous female* can at once be told from the green pyriform *pomi* by being more oval and having a darker green area on the dorsum and the cornicles pale brown instead of black, and very short, slightly swollen, and occasionally with a rusty basal spot.

The *winged viriparous female* has the abdomen green, and short, light brown, swollen cornicles, and the wings different.



[F. Edenden.]

FIG. 114.—*Aphis fitchii* ON APPLE SHOOT.

The *oviparous female* is green, with short swollen cornicles, which are light brown, whilst a rusty red spot occurs at their base.

The *male* is winged and so can be easily told from the male *pomi*, and from the winged male *sorbi* by the greener colour and dusky transverse markings and shorter cornicles.

This species in all its stages can at once be told from the *Aphis pomi* by the shorter and thicker cornicles.

The intermediate food plant has not been definitely traced in this country. Suggestions have been made in America that they go to grasses and wheat. Search in this country failed to reveal any on corn

plants, although the *Aphis fitchii* produced young artificially on Meadow Foxtail, and was found on other grasses. This bears out what we see is said to occur in America and explains their sudden departure from the apples and later return.

PREVENTION AND TREATMENT OF APPLE APHIDES.

The inquiries received regarding treatment come from all parts of the country. Many growers say washing with paraffin emulsion is of little use. This is certainly true, as the ova of any one species I find hatch very unevenly, and the result is, many lice have damaged buds and blossom and curled leaves, whilst others are coming out, and thus a certain number escape the wash. If we wash as soon as they begin to hatch it is no good unless we are prepared to go on every day for perhaps several weeks, an impossible process. Only a penetrative wash will get into the lice protected by curled leaves.



[F. E.]

FIG. 115.—A PARASITE OF THE APPLE APHIS.
(Greatly enlarged.)

After many experiments I eventually have come to the conclusion the most vulnerable time in the life-history of these plant lice is when in the sexual stage in the autumn. When we find the small wingless or winged sexual forms under the leaves is the time to kill them. At this time a heavy paraffin emulsion may be used, as the leaves are of little value and it does not matter if we burn them. The Apple Aphides are then killed before they lay their eggs, and their future attack is guarded against.

The emulsion must not be put on with much force, as the leaves may be knocked off. The tree should have a good spraying, and the ground below well wetted and also the trunk, the oviparous females will then be killed.

I am confident that *autumnal spraying* for these pests is most essential. If it is more troublesome it does good, and the usual spraying when the leaves are curled is often waste of time and money, especially where we have more than one kind of *aphis* at work. For the attack of *Aphis fitchii*, early spraying is, of course, of use, as this species feeds openly, but not for *pomi* and *sorbi*, which curl up the leaves as soon as they open. When the leaves are curled the best wash to use is the tobacco wash.

All prunings should be rigorously burnt before March. Many eggs are thereby destroyed.

Mr. Bear of Magham Down, Hailsham, wrote me on the 15th of

June, 1906, that he was having "the curled leaves stripped off the shoots affected, in the case of apple trees, to prevent spreading, as spraying would not touch a tenth part of them, as they are inside the curled leaves." This seems a tedious affair, but, no doubt, is a very wise one, when one looks over the plantation in the winter, and sees the enormous harm these apple aphides have done.

In Nova Scotia (7) growers have been experimenting with thick lime and salt wash similar to the Chapman wash recommended for Apple Sucker and Plum Aphid. The effect of this treatment on Apple Aphid eggs has been far from satisfactory. The wash will not hold sufficiently firmly on the young shoots where the eggs are mostly placed to prevent the egress of the young aphides.

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THE WOOLLY APHIS.

(*Schizoneura lanigera.* Hausmann.)

The persistent increase of this aphid during the last few years in most of the fruit centres of Britain makes it imperative that growers should take steps to check its increase in their plantations. Of still greater importance is it for nurserymen to see that the stock they send out is free from this insect. During the past few years communications have been sent me by several growers, stating that they have introduced this insect with purchased stock.

One correspondent, writing from Liscard, Cheshire, says: "I have been buying apple trees from various nurserymen, and have introduced American Blight into my orchards, and my gardeners do not seem to be able to check its progress."

Many such quotations could be made from letters received from correspondents.



FIG. 116.—A BAD AND OLD-STANDING ATTACK OF WOOLLY APHIS.

No nurserymen of any standing would dream of sending out apple trees infested with this "blight." I have seen in many cases how carefully they go over the nurseries with hand labour, painting

any patches with methylated spirit, and yet they send out infected stock. The reason is obvious : they either do not know or discard the presence of *Schizoneura lanigera* on the roots. The complete life-history of this apple enemy is well known, but this knowledge is not sufficiently widespread to bear any fruitful results.

So numerous have been inquiries concerning this pest during the last few years, that it is thought that a somewhat fuller account than usual of its life-history should be given here, together with an account of some recent experiments carried out in connection with its prevention and treatment.

The area over which it occurs may be but briefly mentioned ;



[A. V. D. Rintoul.]

FIG. 117.—WOOLLY APHIS ON THE SUCKERS AND SHOOTS OF AN OLD APPLE TREE.

enough to say that wherever apples are grown, the blight also is found.

At one time it seemed to be mainly prevalent in the old west-country orchards in Britain, especially amongst the somewhat ill-kept cider apples. Now we find it just as bad in young plantations of the best varieties all over the country.

It is perhaps most abundant in Worcestershire, and in the Devon orchards, but in all other centres it is an important and increasing enemy. It has been reported to me, or observed in all parts of Kent.

It is most abundant in Surrey. A correspondent, writing from Woking, states that he is much troubled with it, and that he had used lots of mixtures and kept brushing in summer, but without success. Recently I learn that this nurseryman is coping with the root form. Numerous inquiries have come from Cambridgeshire, Huntingdonshire, Norfolk, Suffolk, Cheshire, Yorkshire, Sussex, Hampshire and Oxfordshire. In Wales I have found it in abundance amongst young trees imported from the Midlands at Criccieth, also at Carnarvon and Bangor; in Monmouthshire it was noticed in some gardens. This record of localities could be still further increased.



(F. Etenden.)

FIG. 118.—WOOLLY APHIS AND GALLED AREA
PRODUCED BY IT.

Besides being known under the popular name of Woolly Aphid, it is frequently spoken of as "American Blight." The reason for this is difficult to understand, for it is undoubtedly European, and we are also equally certain that it was introduced into America, just as it has been into Africa and Australasia, with imported stock.

It attacks practically all varieties of apples in this country. In Australia (5 and 6) it is found that apples grafted on Northern Spy and Majetin stocks do not suffer from the ground form, and these are now solely used for

this purpose. Mr. Lounsbury, Government Biologist at the Cape, tells me that no apples unless on these stocks are allowed to be imported into Cape Colony, and that their immunity is found to be the same there as elsewhere. The "May Apple" is also immune in Cape Colony (9). This is a very important point. None of these stocks are used in this country. Nurserymen whom I have spoken to about the subject have expressed their opinions adversely, but I am not aware that anyone has tried them in this country, and until this is done one must naturally believe not only what such great experts as Mr. French, the Government Entomologist of Victoria,

and Mr. Charles Lounsbury state to be a fact, but which fruit-growers of very great skill have proved to be the case in Australia, New Zealand and South Africa.

The mere presence on the trunk and boughs is nothing as long as we can prevent its occurrence below ground.

The damage caused by the Woolly Aphid is particularly severe to young stock, but old trees also suffer in two ways. First, the aphides lessen the vitality of the tree by constantly sucking out the sap; secondly, by the wounds caused by their punctures on young wood, they cause an abnormal growth of soft tissue, which forms rounded swellings, so very characteristic of Woolly Aphid presence (Fig. 119). These swellings split later on, and from them arise those large rugose deformities, so often put down to "canker." At the same time they cause similar damage on the roots, but the swollen gall-like growths that they produce do not necessarily split in the way we find above ground (Fig. 118). In these two ways the life of the tree is gradually sapped, and not infrequently young trees die under this rough usage. In any case stunted deformed trees result, and but scanty and poor quality fruit is borne by the trees.

But there is a third way, I feel certain, in which this Woolly Aphid works injuriously. After keeping records during the past twenty years, I find that in nearly all cases trees infested with canker have or have had Woolly Aphid attacking them. During the summer of 1903 two trees (Worcester Pearmain and a Russet), which were perfectly clean, were infected with Woolly Aphid; next year both were attacked by canker. One tree close to them not attacked by the Schizoneura is still clean.

There is no doubt that indirectly this aphid, by causing wounds of greater extent than any other species on the apple, predisposes the trees to the fungus enemy, for which we have no known remedy.

The importance of knowing the life-history is therefore very great, for it is only by so doing that we can learn how, when and where to apply any satisfactory treatment.



[F. E.]

FIG. 119.—EARLY STAGE OF ATTACK OF WOOLLY APHID ON YOUNG WOOD.

The effect of weather on this *Schizoneura* is nil. It will be just as bad in a wet, cold, as in a warm, dry season. It has been found in this country reproducing on some old trees two days after hard frost and snow, with the temperature down to 17° F. The quantity of wool, the habit of secreting itself in any crevice of bark, or amongst lichens and moss, all tend to protect it.

Besides apples, it now and again will attack pears, but such is certainly very unusual in this country. Notes have been sent a few times of its presence on perry pears, but I have failed to find it myself on that fruit, nor have I yet found it on the wild crabs, but it is found on the latter.

In very severe attacks in bad years it may not only be found on the trunk, twigs and roots, but also on the leaves, and on several occasions it has been detected on fruit, where it has produced discolouration.

LIFE-HISTORY AND HABITS.



[W. H. Hammond.

FIG. 120.

YOUNG WOOD ATTACKED BY
WOOLLY APHIS.

parent, but as a rule they remain in close company for some time, forming a small colony. After moulting they assume the dull purplish-brown to plum-coloured hue of the parent.

It is these viviparously produced young which secrete the large quantities of wool, which may hang down in great festoons from the branches.

These larvae soon commence to produce young like their parents, and this method of reproduction may go on all the summer. Very irregularly and very rarely pupae or nymphs arise from the lice during the summer, which give rise to winged viviparous females.

July to September is said to be the period over which the winged race may occur. On only one occasion have I been able to find the winged form, nor have I ever succeeded in obtaining it artificially. Mr. Fred Smith of Loddington tells me it sometimes occurs in the orchards around Maidstone. The winged viviparous female is dusky chocolate-brown with typical *Schizoneura* venation to the wings.

These females fly from one tree to another, and possibly from orchard to orchard. There are no data to show or even give us any idea how far they may travel.

The winged females produce living young or lice similar to those which form the progeny of the "mother-queens," and these go on reproducing until late autumn, and I have even known successive broods continue right through the winter.

On the approach of autumn, a few males and oviparous females are present. As far as observations carried on over the past twenty years go, I can only say this sexual brood is extremely rare in this country. Twice in twelve years it has occurred on one tree constantly kept under observation.

It must not be ignored, however, as the wintering in the egg stage is of economic importance.

The wingless oviparous female is very small, and may well escape observation. In colour she is dull reddish-yellow, in size no less than .003 inch. The wingless male is, like the oviparous female, quite destitute of a mouth.

This sexual female deposits a single egg and dies, her dead body forming a protection or covering to the shiny dark egg during the winter. From observations so far made, the egg stage takes place close to the base of the tree, always, however, above ground level.

These ova remain frequently hidden in the crevices of the bark all the winter, and in spring they produce a larva (Fig. 124) which soon matures into the "mother-queen" form, and which sets to work at a great rate to produce viviparous young.



[W. H. Hammond.

FIG. 121.—PIECE OF WILD CRAB APPLE
ATTACKED BY WOOLLY APHIS.

Thus in two ways we have the Woolly Aphis carrying on its existence during the winter above ground: (1) as living viviparous females; (2) in the egg stage near the base of the tree. Besides



[F. Edenden.]

FIG. 122.—ROOT FORM OF WOOLLY APHIS.

living on the trunk and other parts above ground, *Schizoneura lanigera* lives (3) on the roots and around the stem below ground. The forms found beneath the soil are just the same as those living above it. There they breed in the same way, produce galled growths on the roots, swollen and cracked areas on the stem, and suck the sap going to the plant.

No ova has as yet been detected below the soil. The actual root form, that is, the race that galls the roots, is augmented during the winter by migrants from above. These latter mainly affect the trunk below the surface soil, and these may and do return in spring to become the aerial race. Moreover, the actual root form migrates to the trunk. As far as I have observed, this migration is not at any fixed period of time, but is spasmodic.



[F. E.]

FIG. 123.
OVUM OF WOOLLY APHIS AND
SHRIVELLED SKIN OF ♀.
(Greatly enlarged.)

The damage done by the root form in this country is certainly severe, but not to the same extent that it is in parts of America. Stedman (1), in his most excellent work in tracing this insect's life-history, shows that in Missouri it is the

ground form that causes so much damage to the apple orchards in the southern half of the State, and to apple nursery stock throughout the State, and further he says that 95 per cent. of the cases of so-called "root-rot" is in reality the result of the attack of Woolly Aphis.

In Britain in 1894 I undoubtedly found this aphis on the roots of apple trees at Shalford, in Surrey, the trees dying under the attack, and again at Albury in the following year. The attack was looked upon as abnormal, and for some years all cases that came under my notice were paid little attention to. This was due entirely to the fact that in some preparations made from material sent me from Paddock Wood, in Kent, *Schizoneura fodiens* was alone present (2). Shortly after, Connold found the galls on the roots, and the matter was placed beyond doubt (3), and the statement concerning *S. fodiens* was seen to be erroneous as far as the general attack of Woolly Blight concerns the apple. The cases sent in were from gardens with currants, lettuce, etc., growing beneath the trees; on re-examining the slides, I find they are *S. fodiens*,* doubtless thought by the senders, owing to their producing white wool, to be the same as the specimens actually on the apple roots.



[F. Edenden.]

FIG. 125.—GALLS CAUSED ON ROOTS BY
WOOLLY APHIS.

the "gas treatment," and cleared the pest by such means.

* This is now known to be the same as the Elm Leaf Woolly Aphis (*Schizoneura ulmi*).



[F. E.]

FIG. 124.—YOUNG WOOLLY
APHIS HATCHED FROM EGG.

During the past five years very many cases of the ground form have been examined, and many reported to me by growers.

Mr. Wood of Crockenhall (4) has been the first to recognise this fact in its practical importance; having lifted no less than 40,000 young stock, more or less infested with this pest, he treated it with

Failures in treatment are all because we ignore the presence of the migrating ground form, which we so often know occurs where the aerial form does, just as happens with the Vine Phylloxera (*Phylloxera devastatrix*).

That the Currant Root Louse (*Schizoneura fodiens*) attacks the apple there is no doubt, but this is only where currants, etc., are grown under apple trees (2). That this is exceptional, and that it is the Woolly Aphis that causes the main loss to apple is, however, now an established fact, and is becoming well known amongst all up-to-date growers.

Thus we have this apple pest living during the winter in three ways: (1) above ground as adults, in crevices of the bark, etc.; (2) in the egg stage; and (3) as a root form below ground.

In summer we get it in two conditions only: (1) As active adults forming an aerial race, and (2) as active adults forming a subterranean race.

NATURAL ENEMIES.

These are very few and of no economic importance, except in the case of birds. Of these the Blue Tit (*Parus caeruleus*) is undoubtedly the most important. This useful little bird, which every fruit-grower should encourage, hunts all through the winter for this pest, and does much to lessen its numbers as it does for many other orchard enemies. The Great Tit (*Parus major*), the Tree Creeper (*Certhia familiaris*), and even Sparrows prey upon it during the cold months.

No insect enemies are of any great value as natural checks. Some Coccinellid larvae feed on them, and on some occasions I have seen *Coccinella septem-punctata* clear away colonies of this insect.

A few Syrphid larvae may be seen now and again, but it is very exceptional, and usually happens where we have concomitant attacks of Apple Aphis, which on being destroyed, the Syrphid larvae take to the Woolly Blight.

Rarely larval *Hemerobiidae*, or Lace Wing Flies, have been found with the pest on exposed shoots.

Small dipterous larvae of the genus *Pipiza* were found feeding on the root form in 1899 in some numbers.

Now and again a *Nemocoris* is found sucking their juices, and a few spiders and Harvest-Men (*Phalangidae*) now and then take them.

With the exception of birds, natural checks are of no importance.

PREVENTION AND TREATMENT.

The employment of the Northern Spy and the Majetin varieties for stocks, on account of their immunity, should be well considered by growers and nurserymen as a means of preventing this pest.

The treatment of this disease can only be satisfactorily done if we attack it above and below ground at the same time. There are many washes which will destroy it above ground, granted they are properly employed. It is quite useless to treat trees affected with Woolly *Aphis* with fine sprays. The trees must be not only well wetted, but the wash must be sent with some force and applied to the affected parts for some seconds. It is essential that first of all the wool is removed; unless this is done, I know of no substance, except tobacco, that will penetrate to the insects and so kill them.

A good hard washing with ordinary soft soap and quassia is sufficient, but experience has shown that a small quantity of paraffin is beneficial in summer, not more than 3 per cent. in the wash at this time of year.

In winter I have found Mr. Spencer Pickering's wash of paraffin, soap and caustic soda most beneficial, and I do not think a better one can be used at this time, although caustic alkali wash has been found for the last six years to kill a very large quantity.

No matter which is used, it is more the thorough application than the actual wash that is of account. Unless the trees are heavily wetted and the wash applied from all directions it will have but little effect.

For winter washing for Woolly *Aphis* then, we may use either the old caustic alkali wash or the more improved Woburn wash.

For summer either soft soap and quassia, or a weak paraffin emulsion. *Force is necessary, and plenty of the wash in both cases.*

The ground form in old or established trees may be destroyed by injections of bisulphide of carbon. Nothing else can be used as far as we yet know in this country.

The quantity for each tree, according to size, varies from 2 to 4 oz. This is best applied two feet away from the trunk, four or more injections for each tree at equal intervals around the stem. It is best injected by means of Vermorel's Injector, shown at work in Fig. 126. The depth of injection should be about six inches.

Care must be taken not to put the fluid on a large root. If the point of the injector strikes a root, move to one side of it. The fumes of the bisulphide are deadly to insect life in the soil, and penetrate deeply into it; they are quite innocuous to plant life, but the actual contact of the liquid is harmful.

This ground treatment must be carried out before April, and in *dry weather*. The effect in wet soil is, I have found, as disappointing as it is satisfactory in dry land. Mr. Pickering informs me this cannot be so, as it should be most fatal in damp soil. However, personal experience has proved the reverse two years in succession.

It is very essential that all young stock be fumigated with hydrocyanic acid gas before planting. The stocks may be placed in a greenhouse or tent rigged for the purpose, of known capacity, and then fumigated. When dormant, as at the time of lifting, the bushes may be fumigated at the following strength:—For every 100 cubic feet of



[A. V. D. Rintoul.]

FIG. 126.—INJECTING BISULPHIDE OF CARBON BY MEANS OF THE VERMOREL INJECTOR.

space use 1 oz. of sodium cyanide or potassium cyanide, 1 oz. of sulphuric acid and 4 oz. of water. The trees should be kept in the fumes for 45 minutes. It will be found that the tips may now and then be scorched, especially in some varieties, as the Beauty of Bath and Worcester Pearmain, but no actual damage is done. If nurserymen will not guarantee the stock has been so treated, then it is well worth the grower's while to do so himself.*

* Pickering recommends immersion in petrol for five minutes or in water at 115° F. for ten minutes. This kills the aphis, but neither, as far as I can see, affects the ova, so that fumigation had best be relied on.

Several growers have found considerable benefit from spraying with lime and salt.

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THE APPLE SUCKER.

(*Psylla mali.* Schmidb.)

Of all apple pests this is one of the most troublesome. It has been known for many years, for Kollar (1), quoting Schmidberger in 1837, gives an excellent account of it.

The Apple Sucker belongs to the family *Psyllidae*, of which Edwards (2) describes twenty-eight species in this country. They are related to the Frog-hoppers (*Cicadina*), but can be told at once by their two-jointed tarsi or feet. Three species occur on the apple, of which *P. mali* is by far the most abundant and frequently the only culprit. It has been placed by some of the older writers in the genus *Chermes*, and we even find Ormerod (3) calling it the "apple chermes." It has no connection with that group of insects.

Its attack on the apple is very persistent. This fact, well known to growers who suffer from its ravages, has evidently not been noticed by writers, for we find such statements as the following: "The attack appears to be of only occasional appearance to a serious extent and has been only specially reported to myself in 1890 and 1891, and again in 1897," Ormerod (3).

Growers in Kent, Cambridgeshire, Worcestershire and Surrey report its constant presence. Mr. H. J. W. Best of Suckley tells me it has been a great pest in parts of Worcestershire during the past

twenty years. Mr. Ellis has had it in his plantations near Godalming in Surrey for many years. Many growers in Kent have had it constantly working year after year. Certain plantations are infested more than others, of course, but there are few which I have visited in which it could not be detected. During a tour of inspection in 1906 of the plantations in Worcestershire very few places were found where it was not more or less harmful, and there are growers who considered that the estimated damage to the apple crop, namely 70 per cent., was too low. In some parts it certainly was, for the whole blossom had been destroyed (4). Mr. Denis Best informed me that at one of his plantations at Holt Castle he had picked no apples for fifteen years owing to the Sucker. It is also harmful in Herefordshire. Mr. Getting of Ross writes that it is very troublesome to some of his apples. The insect is also common in Norfolk, Huntingdonshire, Oxfordshire, Dorsetshire and Gloucestershire. During a visit to some Devon plantations in 1906 and 1907 very little of this apple enemy was detected and growers there scarcely knew what it was. Mr. W. Bear tells me it is not present in his plantations to any extent now at Hailsham.

The damage done by it is mainly to the blossoms, but leaf-buds are also attacked. This latter damage was specially noticed at Wye in 1901. The attacked leaf-buds when they open produce only stunted and deformed leaves (Fig. 127).



FIG. 127.—DAMAGE TO FOLIAGE BY APPLE SUCKER (*b*); NORMAL LEAVES (*a*).

Besides being crinkled and deformed, the foliage presents a pallid appearance, often looking frosted; sometimes these leaves die off, at others they gradually recover.

The damage to the blossom-buds and blossoms is much more marked and abundant. Frequently the buds never properly open and when many of the young "suckers" have entered, the blossom is irreparably damaged before expanding.

If only a few are present then the blossom shows well, but before the petals are ready to fall they shrivel up and a dried brown truss remains. This is a very marked sign of Psylla attack, and it is noticed (4) that the dead blossom hangs on the trees a long time,

often until the fruit is ripe or even the leaves are falling. Furley (6) records that the dead leaves showing Psylla skins remain on the trees up to Christmas, and in several orchards they were noticeable up to March.

This brown appearance has given rise to an idea that the blossom has been struck by frost. That it is Psylla work we can tell by the presence of the small insects in the trusses, and later by their dried grey skins or exuviae which remain attached to the strigs and leaves until the end of the season (Fig. 130). These are mostly pupal skins. It is probable that some of the supposed damage by Sucker is due to the Brown Rot Fungus.

Not all varieties are similarly affected. The Ecklinville may be pointed out as suffering more than any other, possibly owing to the stalks of the blossom being so short. The Blenheim Orange, the Wellington, Lord Grosvenor, Lane's Prince Albert and Quarenden we have seen quite ruined by this pest, but in all parts the Worcester Pearmain appears to suffer least.

LIFE-HISTORY AND HABITS.

The adult *Psylla mali* (Fig. 128) is winged in both sexes. They occur from the middle of May till the middle of November. The colour is very variable.

At first they are greenish-yellow to green, the legs paler and the feet blackish; later they change, some become brownish-yellow, others show dark markings, with even red and yellow. The wings are quite transparent and have greenish or greenish-yellow veins, and they fold over the body in tectiform manner when the insect is at rest.



[F. Edenden.

FIG. 128.—ADULT APPLE SUCKER (*Psylla mali*). ($\times 14$.)

In length they vary from $\frac{1}{10}$ to $\frac{1}{8}$ inch. The venation of the wings is very characteristic and will at once separate this insect from other fruit "Leaf Hoppers" with which they may be confused owing to their jumping habits. At the least shock they skip off the foliage and then frequently use their wings and may be seen taking short flights under and about the trees. The males, according to the

observations of Furley (6) and myself, are usually brighter than the females, but according to Schmidberger (1) it is the reverse; moreover,

the latter describes their colour as being very much more varied than we usually find in England. The male, he says, "in wedding attire is either of a lively green striped on the back with yellow, a dark yellow with broad stripes, or almost completely green with dark yellow dots, the abdomen entirely



FIG. 129.—LARVA AND NYMPH OF APPLE SUCKER.
(Greatly enlarged.)

yellow. The females are of a prettier colour and somewhat larger; the entire back of the female, reaching as far down as the forceps at the extremity of the abdomen, is red, striped with greenish-yellow and brown and the abdomen is orange-yellow or green; they are green or greenish-yellow on other occasions." The amount of variation differs in different places and in different seasons. It is the general greenish shade that will be chiefly noticed by the growers. These adults live on the foliage all the time, sometimes we find them at rest on the boughs and trunks. They apparently do no damage in this stage. Pairing takes place towards September, and from then on into November they deposit their eggs. Before copulating Schmidberger (1) says five or six of them assemble on an apple leaf and each male selects his female, and that whilst pairing is going on a tubercle appears on the last ring of the extreme part of the body, which remains there until pairing is over. The eggs are laid in various places, but especially on the spurs, generally around the leaf-ridges, some placed horizontally, others in a more irregular manner; many others are placed on the fine hairs on the year's growth and some on the buds. I have



FIG. 130.—NYMPH SKINS OF APPLE SUCKER.
($\times 2$.)

[F. Edenden.]

once or twice noticed a few on the smaller boughs. Many years ago Mr. Fred Smith, who first pointed out the eggs to me, noticed that they were often laid in a line, end to end; I have only seen this occasionally since and then when laid amongst the fine hairs. The ova (Figs. 131 and 132) when first laid are almost white, then they become creamy-yellow and later assume a faintly rusty-red hue before hatching. Furley (6) describes them as becoming a pale yellow-red also. They are elongated oval in form, somewhat pointed at the ends, one of which is produced into a thin process which is apparently curled under the egg and cannot easily be seen unless the ovum is very carefully removed. What this process is for we do not at present know.

Furley, in his careful observations, found that in Worcestershire in 1906 very few eggs were laid until the middle of October. In Kent we have found many as early as the 24th of September. Laying certainly may go on until November in late years.

Mr. Getting records (8) that at Ross he found plenty of eggs on the 14th of September, and at Pershore they were observed some days earlier.

With fresh eggs we may also find numbers of empty egg-shells; sometimes I have counted twenty empty shells to one sound one. These are mainly old shells of the previous broods, but some few may have been destroyed by predaceous mites, for in some twigs sent me by Messrs. Caleb Lee and Sons, of Swanley, a small red acarus was watched destroying them. The presence of these old egg-shells is very important. They explain the frequent errors that have been made in regard to washes having destroyed the ova.

Another point of great interest concerning the eggs is the irregularity with which they hatch out. The date not only varies in different localities and in different years, but during the same season in the same plantation. They incubate at different periods according to the variety of apple upon which they are situated. This may be due to the heat generated by the flow of sap regulating their hatching to the time of the bursting of the buds. In 1906 they hatched out at Wye on the 10th of April on one variety of apple, on a different variety next to it not until the 20th.



[F. E.
FIG. 131.
OLD EGG OF APPLE SUCKER,
SHOWING RUPTURE AND PROCESS.
(Greatly enlarged.)]

As much as seven days' difference was noticed at one place by Mr. Furley (at Pinvin); those on the Blenheim Orange hatched on the 3rd of April, those on the Wellington not until the 10th of April, and it was particularly noticed that they hatched first on the Eeklinville, one of the earliest of apples. Not many miles away at Eardiston they did not commence to appear until the 12th.

In Kent they have been found to vary in incubation between the 24th of March and the 27th of April.

Schmidberger records them as hatching in Germany on the 5th of April, simultaneously with the bursting of the leaves.

The small larvæ coming from the ova at once ascend to the buds, and if they are not sufficiently open they may be seen seated on the buds waiting to gain entrance (Fig. 133).

At first the larvæ are yellow to dirty yellow with brown markings, bright red eyes, brown feet, and about the size of a pin-point; their form is seen in the photograph (Fig. 129). They are quite flat, and soon work their way into the folds of the buds and at once commence to feed. Sometimes these little larvæ are quite green, at others quite dark in colour.

Schmidberger found that the larvæ cast their skin on the second day after birth, and soon after this that characteristic

globule, seen on the buds and open trusses, makes its appearance from the larval body, and then the white thread appears by which the oily globule is attached. Another moult takes place in a few days, and then the larva not only is provided with the thread and globule but also with a number of white waxy threads which partly cover its body. The first change I have found may take place ten days after hatching. Until recently the first moult observed by Schmidberger was not seen. In no case have I been able to detect moulting as soon as Schmidberger describes. After changing the second skin the Psylla becomes



[A. V. D. Rintoul.]

FIG. 132.—OVA OF APPLE SUCKER,
SHOWING WHERE DEPOSITED.
(Slightly magnified.)

green all over and the abdomen larger and broader than the thorax, and small rudiments of wing buds appear (Fig. 129).

This is the first nymphal or pupal stage. Like the larva it has a long thread and waxy globule and becomes still further covered with white waxy threads and fine curled hair-like particles.

The third change of skin takes place in from eight to fifteen days and the wing rudiments become more pronounced. After this moult the filament and fine curly threads are mostly pale blue.

The nymphal stages are usually found on the leaves, the fine filaments seem to hold two leaves together and thus shelter the "suckers." Often several nymphs are found close together between the two leaves.

Previous to the moult, the nymph fixes its beak firmly into the leaf and then the skin splits and the winged adult emerges and leaves its cast skin firmly attached to the leaf (Fig. 130).

The whole cycle, from the hatching of the egg to the bursting forth of the imago, takes from four to six weeks.

The colour of the pupæ varies, those found between the leaves are yellower than those which are free on the surface, which are normally green. The antennæ are very marked, being darker at the tips which are bifurcated, the same as in the winged adults.

As far as we know at present the apple is the sole food plant of this *Psylla*. One year I found numbers of it on a hawthorn hedge near some apple trees in my garden, together with some *Psylla crataegi*, but I find they do not breed on the hawthorn and that they evidently only go there for temporary shelter. They may also be found in the winged state on pear and plum and currants when mixed with apple, but they are there only as casual visitors and not for depositing their eggs. As soon as the male has fertilised the female he dies, but the female lives for some days after.

PREVENTION AND TREATMENT

The prevention of the Apple Sucker is no easy matter, owing to their hatching out irregularly. Spraying to kill the young is very



[K. Furley.]

FIG. 133.—YOUNG LARVAE OF APPLE SUCKER WAITING TO ENTER BUDS.

unsatisfactory unless we have only one variety of apple in a plantation. Under such circumstances we may destroy very large numbers by spraying with soft soap and quassia, if we do so when we find them as shown in Fig. 133, namely, waiting outside the buds. Even then not all will be destroyed, as even on the same tree they do not all hatch in one day, or even in a week.

The Duke of Bedford and Mr. Spencer Pickering (10) have found great benefit from spraying with tobacco wash.

The various statements made that certain washes will kill or corrode away, etc., the eggs must be taken with caution. None that I have tried have any appreciable effect in this direction, and the careful experiments carried out by Mr. Furley in conjunction with many Worcestershire growers show clearly that no washes have any material effect in killing the eggs. Nor when we have considered the structure of the *Psylla* ovum, do we think that this is likely to take place, unless the wash is so caustic that the trees would be killed. The various statements as to the mortality in the eggs after spraying have been, of course, given in good faith, but the investigators have not apparently taken into account two factors: first, as pointed out by Schmidberger in 1837, the ova will not hatch on shoots cut off the trees unless they have been cut off a few days only prior to normal hatching; and, secondly, the number of old egg-shells and normal infertile ova.

In one batch of shoots sent me by Mr. Furley from sprayed trees some twelve *Psylla* hatched out of some hundreds of eggs, one might have said the various washes had killed all the rest; unfortunately, untreated twigs were sent and fewer hatched (as it happened) from these than from those which had been sprayed, the reason being that the eggs mostly lose their vitality when the life of the twig is destroyed. Experimenters have also neglected the fact in their "egg-counts" that many old egg-shells remain, and these are what they have probably assumed the wash has destroyed. The old shells can easily be told by being grey and have a ruptured shell. Other ova will be noticed which look dull and sunken; these latter are simply infertile eggs. I have known as much as 80 per cent. of *Psylla* eggs to be infertile. One can only repeat that growers are wasting time in spraying with winter washes to corrode the eggs of these insects. The only treatment found of any use in preventing the young from entering the buds is spraying the trees with the thick lime, salt and waterglass mixture (*vide* appendix). Mr. Howard Chapman first called my attention to this, and was so confident of the good done in his plantations that further experiments were conducted at

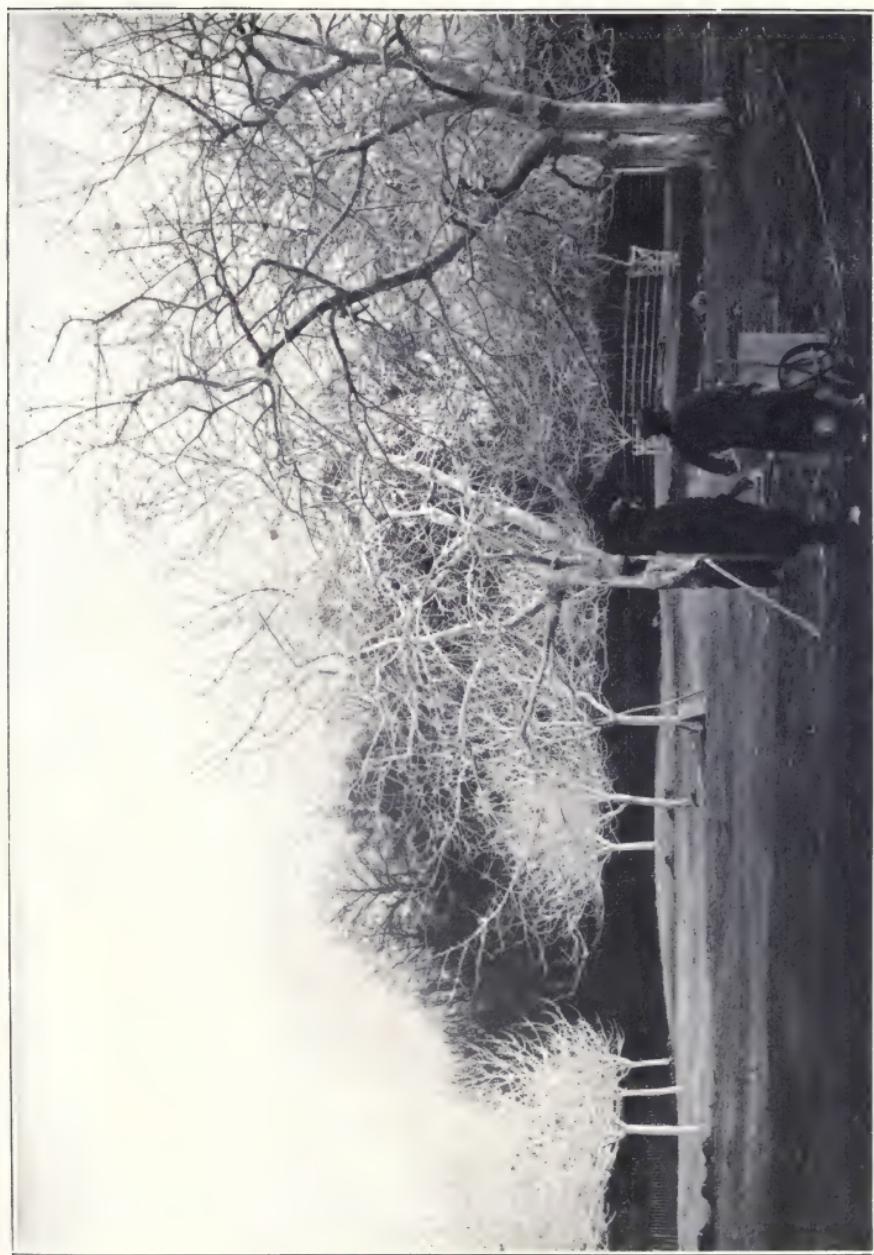
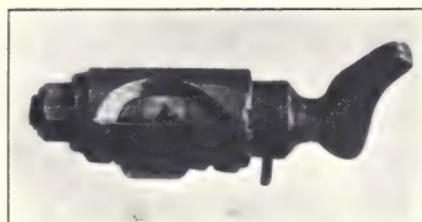


FIG. 134.—ORCHARD SPRAYED WITH LIME AND SALT WASH BY DRAKE AND FLETCHER'S MACHINE AND NOZZLES.

Wye College, and these bore out what Mr. Chapman had found; check trees in both cases being kept. Still more definite results were obtained by Mr. J. H. W. Best of Suckley, and Mr. Montague Taylor of Shelsley Walsh, and Mr. Martin of the Toddington Fruit Grounds, crops of apples being obtained by the former, for the first time for many years, on the treated trees, while the rest of the plantations suffered as usual.

Where failures have taken place such as recorded by Mr. Spencer Pickering (10), and notified to me by Mr. Harnett of Sittingbourne, the cause was probably because the wash was not put on thick enough.*



A



B

FIG. 135.—SENECA NOZZLES USED FOR LIME AND
SALT WASH.

A, set for spraying. B, opened to blow out lime
when blocked.

waterglass is to prevent the wash from flaking off. Many substances have been tried for this purpose, both by Mr. Spencer Pickering and myself, and the same results have been attained; waterglass or paraffin being the only substances found to do good in this respect. The latter, however, I found much inferior to the former.

Spraying when the suckers are in the trusses of the blossom may do a little good if the blossoms are hit fairly hard so as to drive the liquid in, but this may do some harm, and but few are actually touched by the spray owing to their waxy and thready coverings.

* In the former I now learn this was the case.

For this purpose paraffin emulsion does good, but tobacco wash is most successful. The paraffin emulsion was found successful by two large Worcester growers, who made it as follows: soft soap 8 lbs., paraffin 4 gallons, water 100 gallons (8).

But I have noticed that where this wash is used and trickles down into the trusses that scorching often results, and as Mr. Clive Murdock of Linton has pointed out to me, does as much harm as the suckers.

Some few years ago attention was drawn (7) to autumnal spraying with paraffin emulsion to kill the winged adults before



[F. V. Theobald.]

FIG. 136.—APPLE TREE COATED WITH LIME AND SALT TO PREVENT APPLE SUCKER.

they lay their eggs. The time to do this is directly the fruit is picked, and the emulsion may then be used at double its normal strength.

The emulsion must be sent out in a dense spray and directed not only over the leaves but also at the clouds of suckers that fly under the trees.

Mr. Smith of Loddington wrote me in 1905 that very few would be hit, but from personal observations I found that the majority can easily be killed. Mr. Oswald Ellis of Bramley tried this treatment in badly infested plantations in the autumn of 1906,

and the result was that the Psylla were practically exterminated, as they were in my own garden two years previously; and I venture to think, now it has been found successful by a large grower, that it can be made so by others, and that with it and the lime, salt and waterglass treatment the damage done by this serious pest may be greatly reduced.

NATURAL ENEMIES.

So far no insect parasites have been recorded from this pest. A small red acarus was observed once feeding on the eggs, but has not been noticed since.

Schmidberger (1) mentions two mites, one deep red, the other a dirty yellow, which pursued and sucked the young of this insect and cleared them off a pot tree under observation. He also found the light green pupa of one of the garden bugs pursuing the young suckers and piercing them with their beaks.

The Blue Tit and the Long-tailed Tit take a certain number, and I have known shoots quite cleared of the eggs by a family of the latter birds.

No enemies are known, however, which do any appreciable good. Schmidberger (1) describes the adults as "subject to a kind of disease which appears to deprive them of the power of eating, and in this case the leaves on which they are found are not in the slightest degree injured. When thus affected, the head and thorax of the insect are snow white and their abdomens are ringed with black."

This fungus was probably *Entomophthora sphaerosperma* of Fresenius (9), which is common on the Leaf Hoppers *Typhlocyba* spp. This fungoid parasite is white at times and at others pea green.

The ova (Fig. 137) of a Psocid are often sent with those of the Apple Sucker and with Leaf Hoppers. It is possible that these insects prey upon the young suckers.



[F. Edenden.

FIG. 137.—EGGS OF A *Psocid* spp.
Frequently found on fruit trees.
(Greatly enlarged.)

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THE MUSSEL SCALE INSECT.

(*Lepidosaphes ulmi*. Linn.*)

The Mussel Scale, also known as the Oyster-shell Scale, was first definitely described in 1758 by Linnaeus as *Coccus ulmi*. The name by which we have known it in recent years has been wrong, viz., *Mytilaspis pomorum*, of Bouché (1851); moreover, it is now shown not to be a true *Mytilaspis* at all, but belongs to the genus *Lepidosaphes*, Shimer (1868). Its correct nomenclature stands thus, *Lepidosaphes ulmi*, Linnaeus. It has been described under twelve specific names, and six generic names according to M. E. Fernald (1).

Scale Insects are called Coccidae, and are found living as parasites on many plants in all parts of the world, especially in warm climates. They are not only unsightly, but are most injurious to the health of the plant or tree which they attack. Frequently they encrust trees so thickly that death results. Like the Aphid, the Scale Insect feeds upon the sap of the tree, and at the same time blocks up the respiratory pores (lenticels), by encrusting the trunk and boughs with the scaly structures they produce, or their shrivelled bodies or felted secretions. We find scale insects on all parts of trees and plants, on the trunk, boughs, leaves, fruit and even on the roots of some plants.

Many species, such as the one in question, may live on many

* Formerly known as *Mytilaspis pomorum*.

different kinds of trees. We find the Mussel Scale, for instance, on apple, pear, plum, cherry, currant, nectarine and peach, on elm, willow, birch, ash, oak, lime, poplar, cornus, roses, hazel, cob and filbert nuts, and now and then on gooseberries. Fernald (1) gives also for abroad such food plants as butter-nuts, *Stillingia sebifera*, *Ailanthus glandulosus*, *Ceanothus americanus*, *Sassafras officinale*, *Aesculus glabra*, *Syringa persica*, *Cysticus*, etc.

This insect is found in nearly all countries where apples and pears are grown. It is very abundant in North America, in Africa,



[A. V. D. Raintoul.]

FIG. 138.—THE MUSSEL SCALE (*Lepidosaphes ulmi*) ON APPLE TWIG.

in Australia, and New Zealand. It has been distributed by means of nursery stock, and in many of our colonies, etc., its importation is now guarded against by legislation (2).

Normal bark gland markings must not be mistaken for Scale Insects (Fig. 141) (5).

LIFE-HISTORY, HABITS AND STRUCTURE.

To find this scale insect we should go to an old orchard, and examine the trunks of the trees, when a casual search will soon

reveal these little pests. Young trees are often infested too, but one is not so sure of finding them on young, well cared for trees, as on old and neglected ones.

The Mussel Scale is so called because the scale roughly resembles in shape a miniature mussel shell. It is also called the Oyster-shell Bark Louse, because it also bears some similarity to the American Blue-point Oyster. In size and exact shape there is much variation.

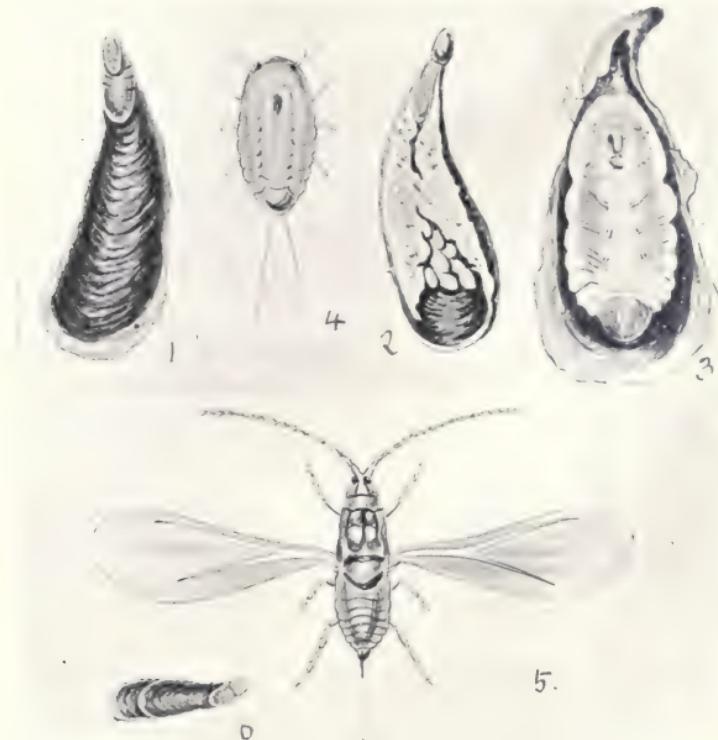


FIG. 139.—THE MUSSEL SCALE (*Lepidosaphes ulmi*).

1, female scale (dorsal view) ($\times 15$); 2, ventral view with ova ($\times 15$); 3, mature female beneath scale ($\times 20$); 4, larva ($\times 50$); 5, male ($\times 35$); 6, male scale ($\times 15$).

(After Newstead.)

Most insects vary in size, the quantity and quality of food regulating the growth. Most mussel scales will be found to vary between $\frac{1}{6}$ and $\frac{1}{8}$ inch in length. In form the hard scale is swollen and rounded at one end, more or less bluntly pointed at the other, the whole scale somewhat flattened in form, and very closely applied to the bark.

A faint, white membrane is seen around the edge of the scale in some specimens. At the pointed end, we notice a smaller scaly area, marked off from the larger. This is the insects' cast skin, the so-called exuvium.

If we lift up one of these scales on the apple tree with the point of a knife some time during the late summer, turn it over and look at it with a magnifying glass, we shall at once see lying at the front end of the scale, a small pale, fleshy mass, which has distinct lines across it. This is the female insect, which has formed, as we shall see, the tiny scale above to serve as a protecting house. With the point of a pin this legless, wingless, feelerless, female can easily be taken from under the scale, and can be more carefully examined. With the aid of a strong magnifying glass her body will be seen

to be somewhat oblong in form. One will notice that there are no traces of any organs of locomotion or any marked external segmented structures, such as the feelers. But in front, we shall see the mouth, which is in the form of long, thread-like structures, often much longer than the body of the insect. This long, thread-like organ is forced deep into the tissue of the apple tree, and by it the sap of the tree is drawn up into the scale insect's body. Now we must show a little patience and search, perhaps for some hours, amongst the scales on the apple trees to look out for the much rarer scale of the male insect.

The male scale can be told from the female

by its much smaller size and squarer build. They cannot always

be found.

If we keep examining the mussel scales on the apple tree into the winter, we shall find that by degrees the female body become smaller and smaller, and eventually remains behind as a shrivelled mass of skin under the scale. As the female shrivels up, we find gradually accumulating, at the broad end of the scale, small oval, grey bodies, looking like dust. These are the eggs of the insect, of which as many as eighty may occur under each scale, but often only thirty to forty, in this country. In fact, the female becomes merely a bag of eggs, and so has carried out her sole function, that of continuing her species. In June, we find that these dust-like eggs hatch out into little active creatures, provided with six short legs and two



[F. E.]

FIG. 140.—PROPUPAL STAGE OF A MALE SCALE INSECT.
($\times 15.$)

antennæ. These grey, larval scale insects crawl from beneath the dried scale, and wander about freely over the tree. Sooner or later they fix upon some definite spot, plunge their long beaks into the plant, and then commences a most remarkable series of changes.

Soon after hatching the larva becomes covered with a greyish-white substance. At this time, the young scale insects may readily be seen on the trees as small whitish specks. If the larva is destined to become a female it never moves again. At first the larva is quite unprotected, but by degrees a waxy excretion exudes from its skin, and the rudiments of a scale form over it. Then it casts its skin and this cast skin also fuses with the waxy covering, and forms that smaller area mentioned before, seen on the front of an old scale. The cast skins entering into the formation of the coccid scale are the so-called exuviae. When the little active larva moults it loses its legs, its feelers, its bristles, and so becomes converted into a footless, almost structureless body, the adult female. We see no pupal stage as noticed in the *aphis*.

Let us now see what happens if the larva is to become a male. It first settles down and, just as in the female, it forms a protecting covering composed of excretions and cast skins, but of very different form from that of the female. Now this larva, instead of degenerating as did the female, casts its skin and enters a kind of pupal stage, called the propupa, in which we find limbs and rudiments of wings forming. When matured, this pupa casts its skin, and from beneath the scale there issues forth a winged insect. The male scale insect has two wings, very different from the four-winged *aphis*, the single pair of wings having but one forked vein to support them. The end of the body is prolonged into a long tube. This tube is inserted by the male under the female scale, and so the female is fertilised. The male then dies. The male mussel scale may now and then be found; but not a hundredth part of the females which lay eggs are ever fertilised by a male. They, like the *aphis*, can produce asexually, that is, without the agency of a male.

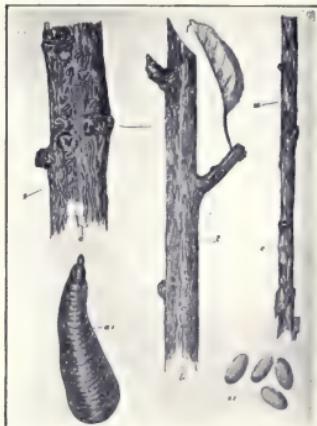


FIG. 141.

Mussel Scale, a^1 and a ; normal bark glands, b ; t ; u , c , cankered scars; a^2 ova.

Some scale insects have the male still rarer, and in others no males whatever have been found.

The little active larvæ appear to be able to wander some distance, and that they do so we know by the fact that we frequently find this mussel scale on the apples and leaves. They are also carried about by various natural agencies, such as the wind, birds, and by other insects. It has been noticed that Ladybird Beetles carry them on their backs from tree to tree.

NATURAL ENEMIES.

Like the *Aphis*, the Scale Insect has several natural enemies. Ladybirds (*Coccinellidae*) and their larvæ or "niggers" devour them, but not to any great extent in our country. Small hymenopterous insects called Chalcid Flies (*Chalcididae*) lay their eggs in them and so destroy them. We are sure to notice many of the mussel scales on the apple trees with minute round holes in them. These are the exit holes of the parasites, very similar to what we observe in the aphides. The Blue Tit (*Parus caeruleus*) and other birds pick the scales off very ravenously, and often destroy large colonies of them. Yet, with all these natural enemies, we get the Mussel Scale often causing a great deal of damage in our orchards, especially when they attack young and tender trees. These natural enemies evidently cannot be relied on to do any appreciable good.

ARTIFICIAL MEANS OF DISTRIBUTION.

This scale is distributed artificially, namely, on nursery stock and on fruit. In this way it has become a world-wide species. On nursery stock it is not easy to detect if present in very small numbers, as the scales so closely resemble the colour of the bark. At the time that stock is lifted for removal the scale insects are in the egg stage.

Fruit also undoubtedly is another way in which it has been carried from country to country; the peel may get thrown about in manure and rubbish heaps in gardens, and then the young larvæ may easily be carried by birds, etc., to the trees.

Thirdly, they undoubtedly come over sea and distances by land on other plants than fruit trees.

GEOGRAPHICAL DISTRIBUTION.

Europe generally, Algeria, Egypt, South Africa, Canada, United States, Brazil, Hawaiian Islands, Japan, New Zealand and Australia.

VARIETIES OF THE MUSSEL SCALE.

There are four well-known varieties:—

- (i.) Variety *vitis* Goethe, found on the grape vine in England, Egypt and Germany.
- (ii.) Variety *ulmi* Douglas, found on the furze (*Ulex europaeus*).
- (iii.) Variety *candida* Newstead, on hawthorn in England.
- (iv.) Variety *japonica* Kuw, found on *Abies firma* in Japan.

PREVENTION AND TREATMENT.

The prevention of Mussel Scale is difficult, as it is undoubtedly to some extent spread by birds and insects. We can, however, guard against its importation with young stock by fumigating it, before planting, with hydrocyanic acid gas.

One of the best remedies is paraffin emulsion. This may be used as a winter wash strong enough to kill the eggs under the scales, or as a summer wash in the dilute form to kill the freshly hatched young. Caustic alkali wash is also found successful by Furley (3). More recently the Woburn wash has been found to act quicker than either paraffin emulsion or caustic soda alone. The following account taken from one of my reports (4) may be quoted here:—

"It may here be mentioned that some 2,000 odd trees were treated in all at Mr. Amos' plantations. Some of the trees were completely coated with the scale so that no bark could be seen. The majority had but few coccids higher than the forks of the trunk, and all had an immense quantity where any band of straw or cloth had been used for staking purposes. In many trees the straw clasps seemed to act as a check to further advance up the tree. A few trees showed but a normal number of scale except under these protections. Frequent observations proved that both Blue Tit (*Parus caeruleus*) and Long-tailed Tit (*P. caudatus*) had done good work and the bands alone protected the scale from them. The scale insect had sprung into such vitality that thousands more of these useful birds could have made no difference however. The orchard was partly down to grass, partly cultivated beneath with gooseberries and black currants, and partly cultivated without any bush fruit beneath.

"The apples in the plantations were the following varieties: Beauty of Bath, Ecklinville, Newton Wonder, Cox's Orange Pippin.

"Two points in the attack were noticed: (1) that the trees on the cultivated land were attacked more than those on the grass land, and (2) that the thin skinned varieties were more damaged than the thick. The latter is readily understandable, but the former is not,

for the trees were in a most unhealthy state (besides being uncultivated), having been subject to a bad attack of Winter Moth for two years, and to a worse attack of Tortrix (*T. rosana*) and Bud Moth (*H. ocellana*), and much Shoot Borer (*Blastodacna hellerella*). Yet the scale had spread much more rapidly on the more healthy trees, than were cultivated, than on the unhealthy trees, uncultivated.

"In January 1905 the whole of the orchards were heavily sprayed with caustic alkali wash.

"The proportions used on the whole were:—10 lbs. caustic soda, 10 lbs. carbonate potash, 100 gallons of water. Unfortunately the owner had sprayed at my advice the whole before the ingredients had been analysed and the percentages were not known.

"To counteract this some trees on the College farm and some of my own were sprayed with 20 lbs. of both (98 per cent.) to 100 gallons of water.

"In all three cases the trees appeared cleaner, but in no case was any apparent damage done to the scales.

"Numbers were examined from time to time, and the eggs were all found intact, not a single one being shrivelled or harmed.

"It was then suggested that lime-washing all the trees would bring the scale off. Nearly 2,000 trees were thus treated, but some fifty were left as checks.

"The lime wash was thoroughly well put on by hand, and well worked up to the forks of the branches. Fresh slack lime was used, and put on as a thick wash. Subsequent rains washed much away, but in June I counted 200 trees still heavily coated.

"This had no more effect than the caustic alkali wash. The only difference noticed was that on the trees washed only with the caustic alkali wash, the eggs hatched out some six or seven days sooner than those which were lime-washed in addition. The lime probably checked the egress of the larvæ mechanically for a time.

"Neither of these methods of treatment, carried out in three separate places, had any effect whatever upon the Mussel Scale.

"Mr. Neild of Holmes Chapel wrote me in 1905 in similar strain, stating that he was disappointed with the result of caustic wash for Mussel Scale, and asking advice *re* paraffin treatment.

"When most of the ova were observed to have hatched in June, the whole of Mr. Amos' orchard was treated with strong paraffin emulsion.

"The 2,000 trees were scrubbed with ordinary hand scrubbing brushes, with the wash. Only the trunks up to the forks were treated, except in a few trees.

"The wash used at first was very strong, owing to the scale encrusting the trees so thickly this was thought necessary. Some seventy trees were scrubbed with the following: 5 lbs. soft soap (Chiswick), 1 gallon paraffin (Tea Rose), 10 gallons water.

"Half an hour after the trees had been scrubbed, the scales were seen to become dull grey. A few hours later the scales were microscopically examined, and the eggs beneath were found to be shrivelled and dead, and all larvae that had hatched out were at once killed. As some leaves close to the forks were seen to scorch at once, and as the ova remaining were seen to be destroyed, the wash was at once reduced to the following proportions: 5 lbs. soft soap, 1 gallon paraffin, 40 gallons of water. This was used for some 200 trees, and



FIG. 142.—SPRAYING MACHINE (FOUR OAKS PATENT).

Useful in small plantations and gardens for Mussel Scale, aphis and caterpillars.

was found to have the desired effect in not only killing the larvae and young scale, but the ova beneath the scale.

"The owner of the orchard, however, doubted about the second formula being strong enough, and scrubbed the remainder of the trees with the strong solution.

"A few trees were sprayed all over with both the concentrated and dilute emulsions, in neither case was any serious damage done to the foliage; although a few delicate leaves were seen to be scorched, in July they looked quite healthy and bore good fruit. Needless to say, only a very fine mist was sent over the trees. Probably under other circumstances damage would result, so the spraying treatment cannot be advised during the summer. Strong paraffin emulsion causes

the scales to turn grey, partly corrodes them away, and penetrates under the scales, and so destroys the eggs. We should use this as a winter wash, when it is less likely to do any harm, there always being a risk of damage to the trees when paraffin emulsion is used in summer. Of the 2,000 trees treated, six were said to be killed, and ten badly damaged. These were all around the tanks where the wash was prepared, and it is probable that the first few pailfuls of wash were not properly mixed, and then the trees had an extra dose of paraffin. This may or may not be so, but according to the men working in the plantation the death was mainly due to old and repeated canker.

"The effect on the bark of some trees was very marked, peculiar irregular cracks being formed, but none of these trees have been damaged, and have blossomed well. *The weaker mixture was found sufficiently strong to kill this pest, and for summer work it is the better to use.*

"Two trees were sprayed with pure paraffin in the winter, in neither case was any damage done to the tree, and all the scale was destroyed."

The experiments conducted by Furley (3) in Worcestershire point to three washes being successful in killing the eggs, namely, caustic alkali wash, paraffin emulsion, and the Woburn wash (7). The latter and the alkali wash worked more rapidly than the emulsion, but the former is undoubtedly harmful to the trees.

Lime-salt-sulphur wash had been previously experimented with, and was not tried again at Mr. Amos' as the paraffin treatment seemed to be the most successful. But Mr. Paget-Norbury writes from Malvern that he has found this useful, quite 50 per cent. being killed by it (6).

In conclusion, we may say that for Mussel Scale in the egg stage, or when the females are completely protected by their brown covering, the employment of paraffin emulsion or the Woburn wash is the most successful method of treatment. In winter the strong mixture of emulsion may be used, up to 7 or 8 gallons of paraffin per 100 gallons of wash being necessary; in June it was found that it had some, but not much, ill-effect upon the bark; the weaker solution had not, and thus this should be used when there is a bad attack in summer. Somewhere about the first week in June the scale-insects hatch out, and then, if present in only small quantities, they may be held in check by spraying all the tree with soft soap and paraffin (10 lbs. of soap, 2 gallons of paraffin to 100 gallons of water), or even soap and quassia.

The paraffin treatment should never be adopted in summer unless the attack is very severe.

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THE BROWN SOFT SCALE.

(Lecanium capreae. Linn.)

This scale insect was sent me in 1904 on apple twigs from Ross by Mr. Getting, with a note that they occurred here and there all over the plantations. Mr. Murdock of Westerhill, Linton, sent the same in 1906, and specimens on the apple were sent from Devon by Major Vigors in 1902. Although no bad attack of this scale insect has occurred, the very fact of its wide distribution, which is said by Newstead (1) to be general in suitable localities throughout England, makes it of importance. Carpenter records it from apple in County Cavan and on peach at Ballyhaire in Ireland. The scale insect is a large brown, soft, scale-like body, shown in Fig. 143.

That it may under certain circumstances increase abnormally we gather from Newstead's description of it killing large patches of a hawthorn hedge skirting the borders of the city of Chester.

The food plants are extremely variable, including the following given by Fernald (2) and Newstead (1):—*Salix*, linden, poplar, *Pyrus malus*, *P. communis*, *P. domesticus* (Fernald), hawthorn, *Cotoneaster*, elm, sycamore, oak, alder, wild and cultivated roses

hazel, horse chestnut, laurel, cherry, sloe and euonymus. Reh (3) also gives, in addition, *Prunus armeniaca*. It seems to be generally spread over Europe, and Fernald records it in Nova Scotia, a probable introduction. It seems to be rare in Wales and Scotland. I found it on apples near Criccieth in 1889 in some numbers, but I believe they had been recently imported from the Midlands.

LIFE-HISTORY.

This insect is subject to much variation; the old adult female after death is dusky chestnut-brown, of spherical shape and varies in length about $\frac{1}{3}$ to nearly $\frac{1}{2}$ inch, rather less in breadth.

The male is a pale crimson with two broad short wings, two long tail filaments; the puparium is small and elongated oval. The male occurs in April and May. The eggs are pale yellowish-white and hatch at the end of the summer into pink larvae which soon become orange and crimson or red-brown. The first moult takes place before winter, when they are found on the twigs as small elongate brown bodies only $\frac{1}{2}$ inch long. In spring dusky transverse stripes appear and the sexes can be separated. By the time the males are ready to hatch, the females are mature, and the winged males fertilise them. Egg-laying then commences. A healthy average female, says Newstead, lays about 2,000 eggs.

NATURAL ENEMIES.

Newstead records a small hymenopterous parasite (*Blastothrix sericea*, Dal.) as a great enemy. This small parasite produces deformities in the scale insect altering its external form. When the parasite escapes, a small hole is seen in the dried female (so-called scale).

Birds also destroy numbers.

TREATMENT.

This insect, should it appear in large numbers in a plantation, would be best attacked by paraffin emulsion in late summer after the larvae have hatched.



[F. E.
FIG. 143.—BROWN SOFT SCALE.
(*Leucanitum capreae*).

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APRICOT.

LIST OF INSECTS INJURIOUS TO THE APRICOT.

COLEOPTERA.

RED-LEGGED WEEVIL (*Otiorhynchus tenebricosus*). Foliage and buds (*vide* Raspberry).

BARK BEETLE (*Scolytus rugulosus*. Ratz.). Bark, p. 111.

SHOT BORER BEETLE (*Xyleborus dispar*. Fab.). Wood (*vide* Plum).

LEPIDOPTERA.

RED-BANDED CLEARWING MOTH (*Ægeria myopiformis*. Bork.). Bark, p. 17.

MAGPIE MOTH (*Abraxas grossulariata*. Linn.), p. 206.

WINTER MOTH (*Cheimatobia brumata*. Linn.). Foliage and blossom, p. 50.

MOTTLED UMBER MOTH (*Hybernia defoliaria*. Clerck.) Foliage, p. 58.

BUD MOTH (*Hedya ocellana*. Fab.). Buds and foliage and blossom, p. 82.

THE SMALL APRICOT AND VINE MOTH (*Batodes angustiorana*. Haw.) Leaves, p. 181.

HEMIPTERA.

PEACH APHIS (*Aphis amygdali*. Fons.). Foliage (*vide* Peach).

PEACH SCALE (*Lecanium persicæ*. Geoff.). Wood (*vide* Peach).

CRUSTACEA.

WOODLICE (*Oniscidae*). Ripe fruit.

THE SMALL APRICOT AND VINE MOTH.

(*Batodes angustiorana*. Haw.)

This small Tortrix moth feeds on a great variety of trees in its caterpillar stage, especially noticeable amongst fruit, as food plants, are the apricot, vine and pear. The moth is fairly widely distributed, and now and then does much harm to wall fruit, and also occurs on the apricot in the open in sufficient numbers to damage the foliage. It is also known as *Ditula angustiorana*.

LIFE-HISTORY AND HABITS.

The moth appears in June, July and August. It varies from $\frac{1}{2}$ to nearly $\frac{2}{3}$ inch in wing expanse. The female has reddish-brown to reddish-ochreous fore wings, with reddish-brown markings as follows: a basal patch forming an oblique streak, a reddish-brown central spot reaching nearly to the anal angle, between it and the central band is a pale yellow costal spot; the male is of a greyish-ochreous colour with brown and black markings.

The eggs are laid on the twigs and hatch out early in spring. The larvae are somewhat variable, some are greyish-green, others yellowish-green with slightly paler spots, from which arise delicate pale hairs; the head varies from pale brown to green, and is very shiny. There are the normal number of legs, which are green, and when mature the length is rather more than $\frac{1}{2}$ inch. They become especially noticeable in April and May and continue into June. They curl the leaves up into tubes, in which they live; usually a single leaf is made into the tube, but sometimes they spin two together. They are very active when disturbed, wriggling backwards after the manner of all Tortrices and lower themselves from the tubes by a strand of silk. Pupation takes place in the leaf chambers. The eggs appear to hatch out irregularly, for we find caterpillars of all sizes at the same time.

On the vine these caterpillars eat the leaves and spin the fruit clusters together and so ruin them.

TREATMENT.

It is always advisable to crush the little caterpillars in the tubes, or, better still, jar the stems and branches and so cause them to leave their shelter, when they may be taken off without any damage to the tender leaves.

Arsenate of lead may be used as soon as the bloom is set, and in winter an occasional spraying with lime and salt or caustic wash does some good.

In the case of vines little harm is ever done in this country, and it calls for no special treatment. Properly kept vineyards, cleaned down every season, are not likely to suffer from the *Tortrix* larvae.

CHERRY.

LIST OF INSECTS INJURIOUS TO THE CHERRY.

A. LEPIDOPTERA.

- LARGE TORTOISESHELL BUTTERFLY (*Vanessa polychloros*. Linn.). Foliage, p. 186.
 WINTER MOTH (*Cheimatobia brumata*. Linn.). Foliage and Fruit, p. 50.
 MOTTLED UMBER MOTH (*Hybernia defoliaria*. Clerck.). Foliage and Fruit, p. 58.
 FIGURE-OF-8 MOTH (*Diloba caeruleocephala*. Linn.). Foliage, p. 35.
 LACKEY MOTH (*Clissicampa neustria*. Linn.). Foliage, p. 30.
 GOLD TAIL MOTH (*Porthesia similis*. Fab.). Foliage, p. 27.
 BUFF TIP (*Phalera bucephala*. Linn.). Foliage (*vide Nuts*).
 WOOD LEOPARD (*Zeuzera pyrina*. Linn.). Wood, p. 46.
 CHERRY AND PLUM TREE BORER (*Semasia woeberiana*. Schiff.). Bark, p. 188.
 CHERRY FRUIT MOTH (*Argyresthia nitidella*. Fabr.). Fruit, p. 192.
 PISTOL CASE-BEARER (*Coleophora anatipennella*. Hb.). Foliage, p. 195.

B. COLEOPTERA.

- BARK BEETLE (*Scolytus rugulosus*. Ratz.). Bark and Wood, p. 111.
 COCK CHAFER (*Melolontha vulgaris*. Fab.). Leafage (*vide Raspberry*).
 GARDEN CHAFER (*Phyllopertha horticola*. Linn.). Fruit and Foliage (*vide Raspberry*).
 GREEN LEAF WEEVIL (*Phyllotius maculicornis*. Germ.). Buds and Foliage, p. 119.
 OBLONG LEAF WEEVIL (*Phyllotius oblongus*. Linn.). Buds and Foliage, p. 119.

C. DIPTERA.

- THE CHERRY FRUIT FLY (*Rhagoletis cerasi*. Linn.). Fruit (*vide Appendix*).

D. HYMENOPTERA.

- CHERRY AND PEAR SLUG WORM (*Eriocampa limacina*. Cameron). Foliage (*vide Pear*).

E. HEMIPTERA.

- CHERRY BLACK FLY (*Myzus cerasi*. Fab.). Shoots and Foliage, p. 197.
 THE CHERRY BUG (*Tropicoris rufipes*. Linn.). Foliage and Shoots, p. 199.
 CUCKOO SPIT (*Philænus spumarius*. Linn.). Axils of Foliage, p. 200.

THE LARGE TORTOISESHELL BUTTERFLY.(*Vanessa polychloros.* Linn.)

This beautiful butterfly is now and again sufficiently abundant to do some harm to fruit trees. Owing to the gregarious habits of the caterpillars the damage is especially noticeable, for large circumscribed areas are defoliated by the colonies.

In France the cherry is often attacked by these caterpillars. In this country it also attacks the pear, and I have once found a



{ F. Edeniden.

FIG. 144.—THE LARGE TORTOISESHELL BUTTERFLY (*Vanessa polychloros*)
AND CHRYSALIS.

colony on the apple in Kent. Its chief food plant seems to be the elm, but it also is found on aspen, sallow and osiers. Taschenberg (1) and Kaltenbach (2) also record it from apple in Germany. Ormerod (3) refers to it as damaging cherry trees at Lymington in Hampshire. In the neighbourhood of Wye I have often seen cherry trees, especially sour cherries, stripped by the caterpillars, but not since 1903.

LIFE-HISTORY AND HABITS.

The butterfly is about $2\frac{1}{2}$ to 3 inches across the expanded wings. The colour of the fore wings is rich orange-brown, dusky at the base, marked as shown in the photograph (Fig. 144) with black ; the hind wings are of a similar colour, dusky at the base, with a single black spot at the centre of the upper edge. There is a dusky border to the fore wings and the same to the hind, with dark blue crescents, the largest in the middle. The butterfly appears in July, and many hibernate over the winter in sheltered spots. The eggs are laid in May on the twigs of the food plants, often completely surrounding the twigs in ring-like manner.

The caterpillars live in colonies until their first moult, when they spread over the trees. The young ones cover themselves with a web

*[F. Edenden.*

FIG. 145.—CATERPILLAR OF LARGE TORTOISESHELL BUTTERFLY.

of fine silk, beneath which they live. Buds and young leaves are eaten by them in their early stages, and the twigs in their neighbourhood are soon stripped of all foliage.

The mature caterpillar is black or brownish-black, with a yellow line along the sides, and the yellowish-brown spines have black points, numerous ochreous-brown freckles on the back, forming a longitudinal band bounded by the sub-dorsal spines ; in the middle of the back is a dorsal line of black ; on the sides are numerous grey specks giving a greyish hue ; around the spiracles there is ochreous-brown. When full grown the larva is about 2 inches long.

By mid June they have all dispersed and suspend themselves by the tail and change into the chrysalis state, hanging head downwards. The chrysalis has two rows of tubercles running down the back, yellow at the extremity, ringed with black ; at the thoracic end of

this row of tubercles there are three spots on each side which are mother-of-pearl white, the surrounding area being reddish; these spots become golden, then red; the thorax is reddish; the abdomen ochreous, grizzled with black. They are attached to the twigs and leaves upon which they feed.

TREATMENT is seldom called for, but if they are very abundant the colonies should be collected when young and the mature larvæ might be poisoned with arsenates. All egg-masses should be destroyed.

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- (3) *Ormerod, E. A.* 'Handbook of Insects Injurious to Orchard and Bush Fruits,' p. 50 (1898).
- (4) *Buckler, W.* 'Larvæ of British Butterflies and Moths,' vol. I., p. 54 (1886).

THE CHERRY AND PLUM TREE BORER.

(Semasia wooberiana. Schiff.)*

This insect frequently occurs in the Sittingbourne area in cherry trees. Mr. F. Smith of Loddington informs me it also occurs in the Maidstone region. Stainton (2) says it is widely distributed in Britain and generally common.

The original note sent me concerning this pest was in 1897, and was recorded in the Board of Agriculture Journal (1). It was then stated "that for two or three years a couple of cherry trees, planted about nine years ago, did not make the progress they should have done, and upon close examination little brown deposits were found at the bottom of the trees on the bark; larvæ were discovered. Numerous other trees were seen with deposits near the ground, and it was feared the pest might be spreading."

This was the record of an attack at Rodmersham, near Sittingbourne. It has continued to some extent in Rodmersham to the present time. Mr. Mercer wrote again in 1906 sending "specimens of insects that are doing an immense amount of harm to our cherry trees in the neighbourhood by boring into the bark of the trunk of the tree, and causing large swellings, finally destroying the trees after a few years."

In 1906 Mr. Lewis Levy of Borden Hall, near Sittingbourne,

* The synonymy of this species is as follows:—*Semasia ornatana*, Hb.; *Tortrix ornatana*, Hb.; *G. wooberiana*, Haw. D. L.; *G. weberiana*, Wd.

wrote concerning it, stating that the bark was seriously damaged near the ground of about twenty trees, thirteen years old. It was pointed out that those trees were worst where rough grass was around the base.

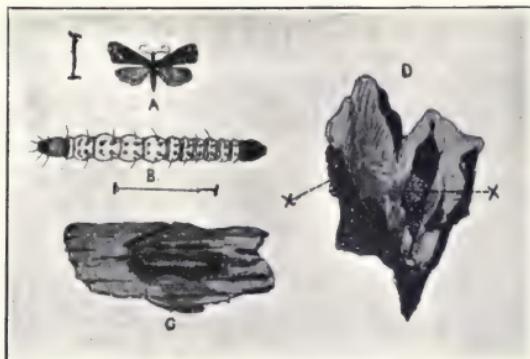


FIG. 146.—PLUM AND CHERRY TREE STEM BORER
(*Semasia woerberiana*).

A, adult (reduced); B, larva; C, larva in wood; D, larval chamber and frass (x).

In 1887 I found it damaging wall peach trees at Kingston-on-Thames, where it eventually caused their death. It is recorded by Wilkinson (8) from the vicinity of Edinburgh and at Belfast, he referring to it as attacking the laurel, almond and apple.



[F. Edenden.]

FIG. 147.—PIECE OF CHERRY BARK (inner side), SHOWING WORKINGS OF THE SEMASIA LARVA.

Kollar (3), Kaltenbach (4) and Taschenberg (5) refer to it in Germany.

The damage is done to apple, plum, cherry, nectarine and peach,

by the caterpillars burrowing under the bark, where they feed on the inner bark and cause an exudation of the sap. Masses of gum appear in the cherry, swellings and rugosities in the others, and the trees will gradually decay under the attack.

The burrows formed by the larvæ are of irregular form, sometimes chamber-like. Air-holes are made by them, and out of these a brown granular "frass" is extruded. These "frass" heaps were particularly noticeable on some pitched trees at Borden Hall, the larvæ eating their way through the pitch for air, and to pass out the excrement. The tunnels formed by the larvæ in some cases passed deep down, and some chambers examined were nearly $2\frac{1}{2}$ inches across.

The attack mainly seems to be on the base of the trunk, and up to about five feet. As many as ten openings were found on the trunk of one tree at Borden which I saw in 1906. The majority of openings are from one to four feet up the trunk.

LIFE-HISTORY.

The moths appear in May and again in September, there being two broods during the year. They settle when at rest on the trunks of the trees, and are then very inconspicuous.

The wing expanse varies from $\frac{1}{2}$ to nearly $\frac{2}{3}$ inch. In colour they are dull orange-brown to chestnut-brown on the fore wings, with dark markings, small dull yellow streaks on the costa, an eye-like spot on the tip of each wing, and a pearly border enclosing three dark lines; the under wings are unicolorous brown. The moths appeared in 1901 and 1906 on the 21st of May and continued until the 6th of June. They lay their eggs in crevices in the bark or under the rind, and in six days the small caterpillars appear and tunnel at once into the inner bark, where they pupate in late August and in September.

The caterpillars are dull pinkish-white to pale dusky-brown, with a dark bi-lobed head and two large median and small lateral dusky tubercles on the first six segments, a simple hair arising from each; on the four following segments are two small extra dorsal spots behind the two large ones, and the tail end is darker than the rest of the body. The legs and the prolegs are normal. In length they measure a little over $\frac{1}{2}$ inch.

The chestnut-brown pupa works its way partly out of the exit hole before the moth emerges. The pupa is enclosed in a cocoon.



(F. E.)

FIG. 148.—*Semasia iwoberiana*.

The pupal stage is found to last from twenty-one to twenty-five days.

The second brood, which mainly occurs in September, lay their eggs in a similar manner, and the larvae remain feeding under the bark all the winter. They commence to pupate about the 30th of April, and finish by the second week in May.

But in 1906 there were still larvae on the 12th of May. Just previous to hatching the pupæ force their way out of the bark and the moths escape.

PREVENTION AND TREATMENT.

Prevention may possibly be carried out by smearing trees in infested orchards, at the time the moths are about, with some noxious mixture. Cow-dung or clay and lime would make a good mixture;



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FIG. 149.—PUPA OF PLUM AND CHERRY TREE BORER
(*Semasia woerberiana*) PROJECTING FROM BARK.

a good smearing of grease, if a pure sample is obtained, might be similarly used.

Mr. Levy's plan of thickly coating the stems with pitch has been found to do no harm to the trees, and has certainly reduced the numbers of the insect. A good brushing or painting with arsenate of lead and clay might kill the caterpillars eating in or out of the trunk if put on thickly.* If only a few trees are attacked the larvae may be killed by cutting into the tunnels with a knife or probing with a stiff wire.

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* This has been tried by Mr. Honeyball of Teynham, but found to do no good.

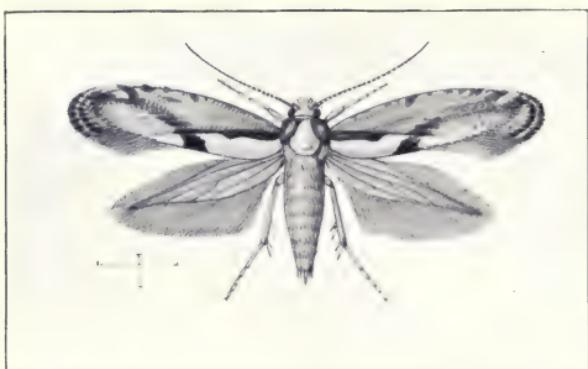
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- (6) *Theobald, F. V.* Report on Economic Zoology for year ending April 1st, 1906, pp. 39-42 (1906).
- (7) *Theobald, F. V.* Report on Economic Zoology for the year ending April 1st, 1907, pp. 45-47 (1907).
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THE CHERRY FRUIT MOTH.

(Argyresthia nitidella. Fabr.)

The only references I know of to this insect are an account given by Whitehead (1) in 1896, from which these notes are taken, and a further record in 1898 (4).

Inquiries made amongst cherry growers in Kent have failed to obtain any information of such an attack during recent years.



|Horace Knight.

FIG. 150.—CHERRY FRUIT MOTH (*Argyresthia nitidella*).

Another closely allied fruit pest occurs in Britain which is often very harmful on the Continent, namely, *A. conjugella*, Zell., which is excellently described and figured by Lampa (2). The differences between these species are pointed out later. The damage recorded to cherries by Whitehead is best given in his own words:—"In the beginning of May it is often noticed that the small cherries look unhealthy just after the fruit has 'set,' and that later on many fall off. If these fallen cherries are closely examined, in many cases a hole will be found evidently caused by some insect. In the spring of this year (1896) so many complaints were received of the unhealthy state of cherry trees that investigation was made, and it was

seen that there was a very small maggot, or larva, in a large percentage of the fruitlets, which were about the size of a small grain of wheat, and still had on the floral envelopes or 'caps.'

LIFE-HISTORY.

This small moth belongs to the Tineina and to the family *Argyresthiidae*, of which we have thirty-two species in this country of which no less than twenty-four belong to the genus *Argyresthia*.

The species referred to by Whitehead as a cherry enemy normally lives in the shoots of hawthorn, according to Stainton (3).

Whitehead describes the specimens as $5\frac{1}{2}$ lines across the wings; the fore wings light brown, with white or cream-coloured inner margins. In the middle there is a fascia of a deeper brown colour which terminates in the tip of the wings. This certainly answers to Stainton's description of the species, and not to *A. conjugella*, which one would imagine this cherry pest to be, or still more likely *A. ephippella*, which is normally found on the cherry.

The moth is said to place its eggs on the shoots near the flower buds, where they remain during the winter, and the caterpillars hatch just when the flowers are forming, and enter them, and later the fruit.

The moth, according to Stainton, appears in May, but Whitehead says the latter part of June and the beginning of July. This is the time *A. ephippella* appears, and is another reason for thinking Whitehead is in error over the identification. The larva in the cherry is described by Whitehead as being light green, becoming grey later on; the head brown, also the first segment; the six true legs brown. It gets into the tiny cherry, in which it is curled up, scoops out the inside, and remains, it seems, for from fifteen to seventeen days in the larval condition. Then it spins up in the cherry and in its withered inflorescence in a densely thick white cocoon, from which in about fifteen days the moth comes forth.

OTHER SPECIES INJURIOUS TO FRUIT.

Two others of this genus injurious to fruit occur in this country, namely, *A. ephippella*, Fab., and *A. conjugella*, Zeller. The first-named has ochreous-brown fore wings; the inner margin white, interrupted beyond the middle by a dark brown spot which can be traced across the wings as an oblique fascia, terminating on the costa.

The second has the fore wings of a purplish fuscous hue, with the inner margin whitish, interrupted beyond the middle by a dark fuscous spot, nearly opposite to which is a dark fuscous spot on the costa; and on the costa towards the tip are two whitish spots.

Wing expanse in both $\frac{1}{2}$ inch.

The larva of *A. conjugella* is described by Stainton (3) as being dull whitish-yellow; the head and second segment pale brown. Lampa(2) figures it pinkish and with additional dark areas on the anal segment. *A. ephippella* feeds in its larval state on shoots of the cherry, according to Stainton, and is found there in May. Taschenberg(5) refers to it in Germany as occurring in May in the leaf-buds of the hazel, in the leaf and blossom buds of the wild plum, the cultivated plum and cherry, in united leaves of *Crataegus terminalis*; also records it on the apple trees as becoming injurious.

It is possible that this is the species referred to by Whitehead.

The second species, *A. conjugella*, feeds in its larval stage in the apple, and has been found in this country in the berries of the roan tree or mountain ash.

Its work in the apple is very marked, small tunnels being made in the pulp of the fruit in all directions.

Warburton (6) described the attack of a new apple pest in Devonshire which he said was due to a caterpillar, "which when bred out will doubtless prove to be an *Argyresthia*," but it does not answer to the description of the larva of *A. conjugella*. The apples become riddled with fine winding burrows, and Warburton pointed out that when the caterpillars were present it was by no means easy to extract one unhurt, for the complicated windings of the burrows have to be followed with the greatest care. Now and again the borings take a complete loop and the larva enters the fruit again at another point. In bad cases the core had always been reached and one or more of the pips excavated.

The working is just as is described on the Continent, but the difference of the caterpillar is apparent.

The treatment for these fruit pests is little understood; probably spraying with arsenate of lead will be found successful.

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- (2) *Lampa, Sven.* 'Uppsatser Praktisk Entomologi,' 16 pp., 1-16 and Taf. 1. Uppsala (1906).
- (3) *Stainton, H. T.* 'A Manual of British Butterflies and Moths,' vol. II., p. 369 (1859).
- (4) *Whitehead, Sir C.* Journal Board of Agriculture, vol. V., No. 1, p. 59 (1898).
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THE CHERRY TREE CASE-BEARER.

(Coleophora anatipennella. Hb.)

This insect is one easily told by the curious case formed by the caterpillar resembling roughly a pistol, and hence it has been called the Pistol Case-Bearer. The first inquiry I had concerning it was in 1893, when a number of the larval cases were sent me from Sellindge with a note regarding the great damage they had been doing to cherry foliage during that year (1). In 1897 a similar attack was noticed at Wye (1), the foliage being denuded by these insects. Inquiries have also been received from Sussex, Surrey and Somersetshire.

The damage done by these insects is chiefly in spring-time, when they come from their winter rest and commence devouring the buds as they open. As the leaves open out they crawl with their cases over the foliage and devour the upper epidermis and the mesophyll, leaving a pale patch of the lower skin, much as is done by the Slugworm.

Lintner (2) refers to an allied species, *C. malivorella*, Riley, doing damage in America.



[F. E.]

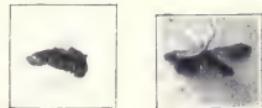


FIG. 151.—LARVAL CASE ON LEAF AND DETACHED, ALSO MOTH OF THE PISTOL CASE-BEARER.

LIFE-HISTORY, ETC.

The adult moth may be found on the wing from July to August, and occurs from Newcastle to the most southern part of England.

The wings are creamy-white, with numerous scattered fuscous scales, which are especially noticeable towards the tips of the wings; the fringes are white; the hind wings are dusky, with long fringes of dusky grey, paler than the wings. The moths are found flying about hedgerows towards evening. In length they reach about $\frac{1}{2}$ inch from wing-tip to wing-tip.

The female lays her eggs on the underside of the leaves. Besides the cherry they lay them also on the apple and the sloe, but it seems to be always the cherry that they attack in numbers.

The ova appear to hatch in two or three weeks. In a few days

the larval cases commence to appear, which form a kind of shell which entirely encloses the larvae in later life.

The larva is reddish-brown to almost orange in colour, with a dark brown shiny head, the anal region darkened, the skin wrinkled; length less than $\frac{1}{2}$ inch. The larval case (Fig. 151) is dark brown to black, pistol shaped, with a white border around the mouth of the

case, slightly swollen at the sides, partially snail - like (helicoid) and much wrinkled.

This case is narrow and more curved when young. The larvae may be found from August through the winter to June. They hatch out from eggs laid in August and on to the early part of September and soon form a house, and continue feeding into the autumn as long as possible. They pass the winter attached by silken strands to the twigs and shoots of the trees, generally in a half-grown state. In early spring they commence



[F. Edenden.
FIG. 152.—AN APPLE CASE-BEARER (*Coleophora* sp.)
AT x AND MOTH.
(An allied insect found on apple.)]

to feed on the buds and unfolding leaves. Pupation takes place inside the "case-house"; the pupa is pale brown, and lasts in that condition for three, four or more weeks. Before the moth emerges the pupa is forced partly out of the case and the sides of the case burst.

NATURAL ENEMIES.

Numerous small hymenoptera are parasitic on this moth. In one instance, namely, at Sellindge, the Rev. S. Patrick found that nearly every case was parasitised. Lintner (2) also refers to a Chalcid parasite of *C. malivorella*.

REMEDIES.

Spraying with arsenate of lead. This should be done in autumn after a bad attack to prevent the larvae from damaging the young leaves, buds, etc., in the following spring.

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- (1) *Theobald, F. V.* Journal S. E. Agricultural College, No. 6, p. 9 (1897).
- (2) *Lintner, J. A.* First Report on Injurious and Other Insects of the State of New York, p. 163 (1882).

THE CHERRY BLACK FLY.

(*Myzus cerasi*. Fab.)

Well known to every cherry grower is the Black Fly, not only in this country, but all over Europe, America, Africa, Australia (4) and New Zealand.

The black aphis of the cherry swarms over the shoots (6) and gets into the leaves, causing them to curl up. So thick do they become some seasons that they not only destroy the leaves, but kill the ends of the shoots. Sometimes the leaves do not curl at once. Fitch refers to this aphis in America, and records as many as 190 ranged down the mid rib of one leaf.

Moreover, they excrete a large quantity of very gummy honeydew, and this falls on the fruit and ruins it. The black fungus grows rapidly on the honeydew of this dolphin, and this, with their excrement, soon ruins the crop. All varieties of cherries are attacked by it all over the kingdom. It also occurs upon red and black currants.

On the large cherry trees in Worcestershire, Mr. Ballard of Eardiston informs me they do not look upon it as a serious pest, yet one sees the top shoots dying from its attack. It is mainly on wall fruit and on young trees that it does much damage, especially to the morello cherry.

Both sweet and sour cherries are used as the host plant. It is also recorded from peaches in Australia (4) and on the plum in America by Thomas (1). Ants are very abundant amongst colonies of this aphis.



FIG. 153.

CHERRY BLACK APHIS (*Myzus cerasi*) ON CHERRY SHOOT.

[F. Edenden.]

LIFE-HISTORY AND HABITS.

The wingless viviparous female is black and rather shiny, with yellowish and black legs. This female as a rule appears low down on the leaves in spring and has sprung from an egg laid on the cherry tree. She soon produces pale lice, which darken and grow

into wingless viviparous females, and these seem to ascend to the top shoots, over which they swarm and produce countless living young, which spread on to the leaves and feed beneath them and cause them to curl up, and in dry weather soon kill them. In July many change to pupæ, which have an olive-green appearance with yellowish wing cases. These give rise to winged viviparous females, which have a black thorax, greenish abdomen and black cornicles, with broad transparent wings ; this female is about $\frac{1}{2}$ inch long. What becomes of these I do not know. They certainly suddenly leave the cherry trees.

Buckton (5) records the viviparous form on the currant at the end of October. Do they fly back to the cherry ?

Certainly we find the eggs on the cherry (6), and the oviparous form has been found there and is described as being dark shiny brown ; the male, which is also found in October, is brownish-black with yellowish abdomen with five brown transverse bars and lateral spots. The egg-laying females I have found as late as the 5th of November on young cherry trees in Kent. The oviparous females are wingless ; the males are winged, and are said by Whitehead to occur in mid September. Each female lays from one to four eggs, sometimes on the shoots, but, I have noticed, especially on any suckers growing round a tree. They are black and shiny and placed near a bud. The time of egg-laying must vary, for we find it recorded from September to October, and it has been seen by myself as late as November.

Wallace (4) records two swarms during the year, one in June and the other in October. The latter swarm contains the males.

PREVENTION AND TREATMENT.

There is no doubt that autumnal washing would do much good by destroying the late generation before the eggs are laid.



[F. E.
FIG. 154.—NYMPH OF THE CHERRY
APHIS (*Myzus cerasi*).
(Greatly enlarged.)

A strong paraffin wash may be used at that time, as the leaves will have done most of their work. No wash will harm the eggs.

As a remedy there is nothing better than soft soap and quassia; the latter is most essential for this pest, as it cleans off the foul black debris; the more put into the wash the better.

The time to spray is when the black fly are as seen in the photograph, namely, collected on the shoots, before the leaves are invaded. Two washings are usually necessary.

Good results have also been obtained with tobacco and soft soap wash.

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- (1) *Thomas, C.* Third Annual Report of the State Entomologist of Illinois, p. 75.
- (2) *Whitehead, Sir C.* Report on Insects Injurious to Fruit, p. 78 (1886).
- (3) *Ormerod, E. A.* 'Handbook of Insects Injurious to Orchard and Bush Fruits,' p. 49 (1898).
- (4) *French, C.* 'A Handbook of the Destructive Insects of Victoria,' pt. II., pp. 9-18 (1893).
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A COMMON SHIELD BUG (*Tropicoris rufipes*. Linn.) ATTACKING CHERRY TREES.

This large and handsome Shield Bug was received from Mr. Emptage in August 1907, with a note that it was swarming over cherry trees at St. Ives, Huntingdonshire, and doing considerable damage. Larvae, nymphs and adults were sent, all taken at the same time.

No mention was made as to whether it had attacked the fruit. An allied species, *Peltophora pedicellata* Kirby, called the Cherry Bug, attacks the fruit in New South Wales (Miscellaneous Publications, No. 538, 'Notes on Australian Hemiptera,' p. 3, 1901. Froggatt).

This is a very abundant insect met with in most localities in woods, fields and gardens. It even occurs in London. Although it is said to be generally carnivorous in habits, and to live mainly on the juices of caterpillars, I do not think that this is the usual food, and believe it to be almost exclusively vegetarian. Professor G. H. Carpenter tells me he finds it mainly vegetarian in Ireland. The specimens received from St. Ives differ from the type in having a yellow apex to the scutellum, not an orange one. Mr. Distant does not know the variety, and it is thus possibly undescribed.

The larvæ and nymphs have a particularly obnoxious smell.

They are easily destroyed by jarring them off the trees and crushing on the ground. It will be interesting to see if this new habit of *Tropicoris rufipes* becomes permanent, or if it will remain an isolated case.

THE CUCKOO SPIT INSECT.

(*Philaenus spumarius*. Linn.)

The so-called Cuckoo Spit Insect is now and again found on fruit trees, especially cherry and apple.

The white frothy substance formed by the larvæ and nymphs is well known, and is especially noticeable on hawthorn hedges and on roses.

The young forms are pale greenish-yellow and are quite covered with the wet froth.

The mature Frog-hopper (Fig 155) is winged, and by means of the wings and hind legs it takes flying leaps into the air. It is abundant

everywhere, and reaches about $\frac{1}{4}$ inch in length. The front wings are brown to yellowish-brown with pale areas; all shades occur, from almost entirely yellow to black, but it may always be told from other related species by the distinctly curved side margins of the elytra.

Should they occur in any numbers on fruit trees they may be easily killed if the trees are heavily washed with water and then sprayed with tobacco wash (*vide* appendix).



[F. Edenden.

FIG. 155.—ADULT FROG-HOPPERS (*Philaenus spumaria*).

CURRANTS.

LIST OF INSECTS, ETC., INJURIOUS TO CurrANTS.

A. LEPIDOPTERA.

- CURRENT CLEARWING (*Egeria tipuliformis*. Clerck.). Shoots, p. 203.
 CURRENT MOTH (*Abraxas grossulariata*. Linn.). Foliage and Buds, p. 206.
 WINTER MOTH (*Cheimatobia brumata*. Linn.). Foliage, p. 50.
 CURRENT AND HOP PUG MOTH (*Eupithecia assimilata*. Gn.). Foliage, p. 211.
 CURRENT FRUIT AND SHOOT BORER (*Incurvaria capitella*. Clerck.). Shoots and Fruit, p. 213.
 CURRENT FRUIT MOTH (*Spilonota roborana*. Tr.). Fruit, p. 212.

B. HYMENOPTERA.

- CURRENT AND GOOSEBERRY SAWFLY (*Nematus ribesii*. Cameron). Foliage, p. 226.

C. COLEOPTERA.

- THE GLAUCOUS LEAF WEEVIL (*Phyllobius calcaratus*. Fab.). Foliage and Buds, p. 215.

D. HEMIPTERA.

- CURRENT ROOT LOUSE (*Schizoneura fodiens*. Buckton).* Roots, p. 221.
 CURRENT BLISTER LEAF APHIS (*Rhopalosiphum ribesii*. Linn.). Foliage, p. 216.
 CURRENT LEAF AND SHOOT APHIS (*Myzus ribis*. Linn.). Foliage and Shoots, p. 216.
 BROWN CURRENT SCALE (*Lecanium persicae* var. *sarothamni*. Douglas). Wood and Shoots, p. 226.
 WHITE WOOLLY CURRENT SCALE (*Pulvinaria vitis* var. *ribesiae*. Sig.). Wood and Shoots, p. 223.

E. ACARINA (Mites).

- CURRENT GALL MITE (*Eriophyes ribis*. Nalepa). Buds, p. 231.

THE CurrANT CLEARWING.

(*Egeria tipuliformis*. Linn.)

This common moth is closely allied to the Apple Clearwing (p. 17). It is known also under the popular name of Currant Borer, and is sometimes spoken of scientifically as *Sesia tipuliformis*.

* This is now known to be *Schizoneura ulmi*, the Leaf-Curling Elm Aphid.

It is well known to most currant growers, being fairly widely distributed over England and on the Continent, but only occasionally is it found in sufficient numbers to cause any serious damage. It is well known in Germany, and I have found it working in considerable numbers in Normandy and Picardy(1). From Europe it has been imported, according to Lintner (2), into America, where it is also destructive to the currant.

Red, white and black currants are attacked, but it is especially the latter which suffer. Mr. Buley, writing me from Woodnesborough in 1906, said that he had found it boring into the gooseberry.

Reports of its damage have also reached me from Cambridge, from several places around London, and many in Kent.

LIFE-HISTORY, ETC.

The moth (Fig. 156) is a little more than $\frac{2}{3}$ inch in expanse of wings and about $\frac{1}{2}$ inch in length of body. The abdomen is metallic black or bluish, the segments edged with yellow, the abdomen thus being banded with three yellow stripes in the female and four in the male, the apex ending in a fan-shaped mass of metallic purple or black hair-like scales. The thorax is also metallic purple with a yellow stripe on each side. The fore wings are transparent, the upper margin black with a dark orange tint on the upper edge; tip streaked with black; lower edge black, tinged with orange; hind wings with black margins, tinged with orange; fringes black.

The moths appear mainly in June. The earliest record I have is 25th of May, when I found numbers in a garden at Ealing in 1884.

One habit I have repeatedly noticed in this species is that they always occur on the wing early in the day, between seven and ten seeming to be the favourite hours, and then only on warm, sunny mornings. They are seen hovering around the bushes, now and again settling on the leaves and sunning themselves. Once in 1892 I found them in

numbers in a garden at Cambridge resting on the stems and on the undersides of the leaves of red currants during the latter part of the day.

The female lays her eggs on the stems; as a rule I only found one placed on each stem.

The eggs are oval and yellowish-white in colour and seem to be mainly laid near where a small shoot or a bud arises. In ten days



(F. E.)

FIG. 156.—CURRANT CLEARWING
MOTH.

(probably the time is variable) a minute white larva comes forth, devours its egg-shell, bores its way into the pith, often first working its way into a tender side-shoot of old bushes. This small shoot soon dies and falls off, and in many cases leaves behind a small hole in the stem, or the bud dies in a similar way. On reaching the pith the larva works both upwards and downwards, but in all the damaged shoots I have examined the white larva has had its head pointing upwards.

In this position the caterpillar remains during the winter. The larva is creamy-white, the head chestnut-brown and very shiny, and which when retracted into the first segment shows through it, giving the segment a dark appearance; the remaining segments have each two pairs of oval shiny wart-like markings on the dorsal surface; the anal segment is yellowish-brown with four large hairs; the other segment has two pairs of hairs, except the first, which has three; the third segment from the tail has two black spots on the posterior edge of the dorsum; the spiracles are black; legs brown, and the prolegs have black edges.

The larvae commence to pupate in April. Morris (3) states that they may remain in the larval state till May.

The pupa is chestnut-brown; the posterior edges of the segments have a number of spines on the dorsal surface, and the head is rather prolonged in front.

Before the imago emerges, the pupa forces its way partly out of the hole formed by the larva.

The emergence usually takes place in the early morning. The general signs of the presence of this insect in a plantation are as follows:—

- (i) In early summer the dying-off of the shoots, smallness of the leaves and the fruit.
- (ii) In winter one may detect the holes into the shoots referred to; these are about $\frac{1}{8}$ inch across, and a quantity of "frass" may often be seen around this hole.
- (iii) On cutting open a dead shoot the white larva may be found within during the winter and early spring.

PRÉVENTION.

All that can be done as far as our present knowledge goes is to go carefully over the bushes, in plantations where the attack occurs, and



[F. E.
FIG. 157.—LARVA OF THE
CURRANT CLEARWING
in situ.
(Natural size.)]

prune off and destroy all those showing the holes mentioned, cutting back until all traces of the black tunnel have disappeared.

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- (1) *Theobald, F. V.* Journal of the South Eastern Agricultural College, No. 5, p. 8 (1897).
- (2) *Lintner, J. A.* First Annual Report of the State Entomologist of New York, p. 8 (1882).
- (3) *Morris, F. O.* 'British Moths,' vol. I., p. 23 (1872).

THE MAGPIE OR Currant MOTH.

(*Abraxas grossulariata*. Linn.)

This pretty moth is known also as the Currant and Gooseberry Moth. Its common name of Magpie Moth is derived from its black and white colours.

It is widely distributed over Britain and is subject to much variation of markings. As a pest it is best known on the currant,



[G. J. Blakey.]

FIG. 158.—LARVE (JUST READY TO PUPATE) AND PUPA OF MAGPIE MOTH.

especially the black currant, but red and white are attacked and gooseberries are often defoliated by them. Complaints have also been received of the harm these insects do to apricot, nuts, and the ornamental ribes.

In 1876 Whitehead (1) records it as being very harmful in

Kentish and Cambridgeshire plantations, and again in 1881 in many English counties and also in Ireland.

Ormerod (2) records its damage from Orkney and Sutherlandshire, from Argyllshire, Fife, Midlothian, Cheshire, Herefordshire, Herts, Wilts and Hants.

I have never had any serious complaints of its damage, except from Surrey and Middlesex.



[A. V. D. Rintoul.]

FIG. 158A.—IMMATURE CATERPILLARS OF THE MAGPIE MOTH.

In Scotland Mr. W. A. Nicholson informs me it was very harmful in Midlothian in 1908.

Practically we can say it occurs all over the British Isles. Currants have been attacked by it in Somersetshire, Devonshire, Kent, Huntingdonshire and Sussex, but in no case was the damage very serious. Most growers whom I have asked about it do not consider it of much importance.

The case is different in gardens, however, for in such sheltered places as walled-in gardens, especially where the currants are trained

against the walls or fences, it is frequently a serious enemy, and it is under such circumstances that it causes much harm to the apricot.

The moth is well known in Germany, where it is called the Harlequin Moth (3). It is also common in France.

The damage is done by the small caterpillars in the spring, but they are usually undetected until they are nearing maturity, and then, the foliage becoming badly eaten, remedies are adopted. The damage, however, is mainly done to the opening buds and young leaves.

Infestation may come from woods and hedgerows. The caterpillars have a very varied diet otherwise than cultivated fruit, for we frequently find them swarming on hazel, sloe, maple, spindle and other trees.

LIFE-HISTORY AND HABITS.

This moth belongs to the same family as the Winter Moth, namely, the *Geometridæ*, the caterpillars being "Loopers" or "Measurers."

The moth is about $1\frac{1}{2}$ inch in wing expanse, but the size is most variable. The writer has bred specimens only $1\frac{1}{4}$ inch, others over $1\frac{3}{4}$ inch across the expanded wings. The colour is creamy-white, spotted with black; the base of the fore wings has orange-yellow between the black spots, and there is a band of yellow on the surface of the wings between the double row of black spots seen in the specimen in the photograph; the hind wings are like the front, but have no yellow; the thorax and abdomen are also yellow and black. The male can be told from the female by the antennae being pectinated. All variations exist; some specimens show very few black spots, others in which the black spots so completely unite that the moth is almost black.



FIG. 159.
THE MAGPIE MOTH (*Abraxas grossulariata*).
[F. Edenden.]

butterfly-like. They fly very leisurely, generally soon after sunset, but it is not uncommon to find them on the wing even during the

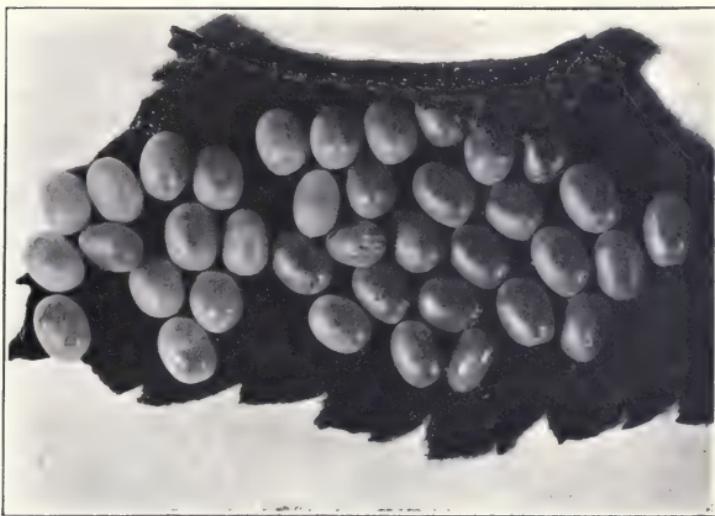
The latter, so-called melanic forms, occur mainly in the damp, humid localities on the west of Scotland, and I have taken melanic varieties in the Channel Islands, notably Sark. The whole structure of the moth is light and fragile, almost

day. This is especially noticeable when walking amongst the vegetation, the movement of the bushes or trees disturbing them.

July and August are the months we find the perfect insects on the wing. They then lay their cream-coloured eggs on the leaves, sometimes singly, at others in groups.

This I have noticed to take place after sunset, but Newman (4) says that they may do so even in the middle of the day.

The eggs (Fig. 160) hatch in from six to fifteen days into small,



{E. Tonge.

FIG. 160.—EGGS OF THE MAGPIE MOTH (*Abraxas grossulariata*). ($\times 10$.)

almost black looper caterpillars which feed upon the leaves as long as there is any nourishment in them. As a rule they reach a little over $\frac{1}{2}$ inch before the leaves have so hardened that the caterpillars have to stop feeding. They then enter winter quarters, which are very varied; some of the small caterpillars seek shelter amongst the dead leaves that collect in the forks and burrs on the bushes, others crawl under stones, wood and debris on the ground.

I have found them in the hollow snags of the bushes, and in the case of gardens they especially choose the holes in the mortar of brick and stone walls and under the boards of outhouses, etc.

In spring they crawl forth as soon as the leafage expands, and at once commence to feed upon the young tender substance. It is during this period that so much harm is done by this insect.

At first the young tender leaves are merely nibbled; later the

caterpillars spread out over the bushes and devour the foliage wholesale. The larvae shown in the accompanying photograph reach when mature about $1\frac{1}{2}$ inch. In colour they are creamy-white, spotted and marked with black and with orange-yellow at the sides. About the end of June the larvae are ready to pupate. They then fix themselves by a small mass of silk at the tail end to a leaf or twig or to any substance near the bush, and change in a delicate cocoon to a black pupa with three golden-yellow rings to the body. From this conspicuous pupa the adult appears in July and August.

PREVENTION AND TREATMENT.

Needless to say all the debris of dead leaves should be "flared" out of the plantation, in dry weather, where this pest is prevalent. This may easily be done by a paraffin torch.



[A. V. D. Rintoul.]

FIG. 161.—ICHNEUMON COCOONS FROM CATERPILLAR OF MAGPIE MOTH.

Ground beneath infested bushes should be well prong-hoed in late winter, and a heavy dressing of soot and lime will often be found beneficial. Some growers have found that smearing cart-grease or Stockholm tar around the stems in early spring has prevented the larvae that have left the bushes from returning. Whitehead records this as having been particularly successful in Gloucester after an attack in 1881. These preventive methods are well worth con-

sidering, but spraying for this insect is perhaps better. Any arsenical wash will poison the caterpillars. Just as in previously mentioned enemies so with this one, arsenate of lead will be found the most successful poison spray. Regarding the time to spray there may be divergence of opinion. Some would leave it until the late spring, when the black and white caterpillars are seen working. We must remember that it is in their early spring life that the chief damage is done. Is it not then better to prevent this by autumnal spraying to poison the caterpillars before they hibernate?

Several trials have been made by the writer with the autumnal treatment and no signs of the caterpillars have been seen in the succeeding year. In gardens where currants are trained against walls, one must remember that the crevices between the bricks are often their winter habitations, and in such cases repointing the walls has been found of great advantage.

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- (2) *Ormerod, E. A.* 'Handbook of Insects Injurious to Orchard and Bush Fruits,' p. 89 (1898).
- (3) *Taschenberg, E. L.* 'Praktische Insekten-kunde,' III., p. 159 (1880).
- (4) *Newman, E.* 'British Moths,' p. 99 (1869).

THE CURRANT AND HOP PUG MOTH.

(*Eupithecia assimilata.* Gn.)

The caterpillars of this moth now and again do some damage to all three varieties of currants, and also feed on the hop. The moth is a little more than $\frac{3}{4}$ inch in wing expanse, the fore wings light blackish-brown, with a grey to almost white line across. It is found on the wing in May and June.

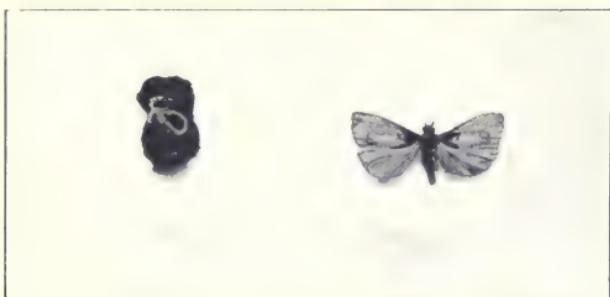
The larva is yellowish-green, thickly covered with small yellowish-green raised spots, the divisions of the segments yellow and a dark green line along the back and one below it on each side; the larvae show considerable variation. They are mostly noticeable in September and October. Pupation takes place in an earthen cell in the soil. The pupa is yellowish-green. Spraying in autumn with arsenate of lead would suffice to keep this moth in check, if it ever increases sufficiently to need treatment.

A Currant Fruit Moth.

(Spilonota roborana. Tr.?)

When investigating the condition of the orchards and plantations in Worcestershire in 1906, my attention was drawn to a curious attack in black currants by Mr. Denis Best at Temple Laugherne and by Captain Crane at Stourport and others (2). The attacked berries when seen in August were still hanging in a mummified condition on the bushes and all showed, as pointed out to me by those on the spot, the large round hole seen in the photograph (Fig. 162).

Collinge also reports this pest in Worcestershire at Mr. Best's (1), and says it is *Spilonota roborana*.



(F. Edenden.)

FIG. 162.—A BLACK CURRANT FRUIT MOTH (sp?) AND ATTACKED CURRANT.

The larvae apparently feed in the ripening currants, hollow them out, and then leave them as dried masses which hang on after the fruit is gathered. Pupae were found amongst dead leaves on the bushes and from these two moths were bred out, namely *Spilonota roborana* and *Hemerosia rheediella*; which is the culprit is not known definitely at present, and I am not sure that it is either, for the mere finding of pupae spun up around the damaged fruit is not necessarily a sign that they have come from the larvae eating the currants.

Until some more observations have been made it is not advisable to deal with this subject further.

The *Spilonota roborana* bred from pupae taken from Captain Crane's bushes feeds normally in rose shoots, but occurs now and then on apple and other plants; it appears in April and May.

These facts do not tally with the damage done to the currants.

The other species bred out, *Hemerosia rheediella*, normally feeds on apple and hawthorn.

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THE FRUIT AND CURRANT-SHOOT BORER.

(*Incurvaria capitella.* Fab.)

This Tineid Moth goes through a very curious series of changes during its growth and development and is of particular interest. It is sometimes harmful to red currants and also attacks the black and white varieties.

The damage is caused by the larva tunnelling up the young shoots, causing them first to flag and then die right back.

The appearance of the withered tips is very marked and will at once show the presence of this insect in our plantations. It has been but seldom reported to me. In 1899 and again in 1902 some inquiries were received from mid Kent and in 1904 one from Worcestershire. It has also been observed at work near Esher in Surrey, and near Cambridge and at Wye. Ormerod (1) records it from Gloucestershire, in the Toddington Fruit Grounds at Winchcombe.

Warburton (5) records it from Worcestershire.

LIFE-HISTORY, HABITS, ETC.

The moth is a pretty insect about $\frac{1}{2}$ inch in spread of wings. The fore wings are dark brown and have when fresh a satiny lustre, showing in the sunlight a purplish tinge ; towards the base of each is a yellow band running across the wings and nearer the tip are two yellow spots ; the hind wings are uniformly grey with faint purplish lustre. The head is deep yellow and shows up prominently with the yellow markings on the wings.

The moth delights in the sun and may be found settled on the blossoms of plants, especially I have noticed on Umbelliferae. It is fairly common over the south and middle of England, but does not appear to be found in the north or in Scotland. It is also recorded from north Ireland ; Stainton records it from Alkham near Dover, Bristol, Cambridge, Kingsbury, Middlesex, Manchester, Pembury, Scarborough, Tenterden.

The time of appearance is about the middle to the end of May,

now and then into June. The female places her ova in the young currants, where the small caterpillars pass the first stages of their life. These early stages were followed by Chapman (2), who records the egg-laying process as follows: "The moth sits upon the currant and penetrates it in the lateral region, on one occasion the process occupied three or four minutes, on another, only about thirty seconds. The dates were from the 17th to 20th of May. On examining one of these currants, which was rather more than half grown and with seeds still very soft, two eggs of *cupitella* were found lying free in



[Horace Knight.

FIG. 163.—THE RASPBERRY SHOOT MOTH (*Incurvaria capitella*).

Larva, adult and larva in shoot.

the ovarian cavity; in another, the cavity contained two such pairs of eggs.

The ova are colourless and lemon-shaped, about 0·67 mm. long.

The small caterpillars which hatch from these eggs feed upon the seeds. The fruitlets become prematurely coloured and in June and July the small caterpillars leave the fruit and spin up small white cocoons on the bark, under the rind or on the bud scales. At this time the little larvae are only about $\frac{1}{2}$ inch long, of an orange-red colour, with rufous head.

In this stage the winter is passed, and in the spring the little larvae crawl forth and bore into the buds and shoots. They tunnel up the shoots after destroying various buds and cause them to flag and die. At first the larvae are bright red, but before becoming mature they become greenish to greenish-white. Stainton (3)

describes the larva as dull greenish, with a red patch on ninth segment; head and second segment black.

In April and May they change to brown pupæ in somewhat loose cocoons in the tunnelled shoots, the pupæ forcing their way partly out before the emergence of the moths.

Warburton (5) noticed that the larvae which "were not stopped by the muslin (bag) took refuge under the little flakes of curled bark on the currant stems and pupated there." In that position fresh pupæ and empty skins of those of last year were found.

PREVENTION.

The only definite plan known to check this pest is to hand-pick the flagging shoots in April before the emergence of the moths. Spraying with caustic alkali wash in winter would be sure to do good, as it would remove old bud scales, etc., and so expose the winter cocoons and might even damage the small larvae.

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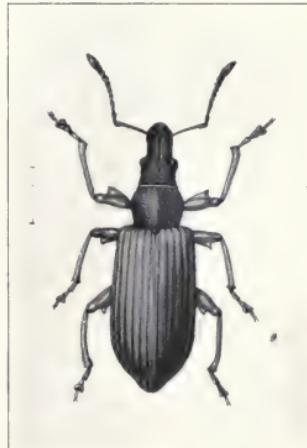
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THE GLAUCOUS LEAF WEEVIL.

(*Phyllobius calcaratus*. Fabr.)

This leaf weevil is recorded by Warburton (1) as doing serious damage to black currant bushes at Bewdley. It usually occurs on alders and various low bushes in hedges. The weevil is locally common and is said by Fowler (2) to be generally distributed throughout England; common in Scotland (Solway, Tay, Dee, etc.); Ireland, near Dublin, and most likely widely distributed.

It is a large and conspicuous species often nearly $\frac{1}{2}$ inch long, but sometimes only a little more than $\frac{1}{3}$. Colour black,



[Horace Knight.
FIG. 164.—*Phyllobius calcaratus*.

clothed with long and narrow, yellowish-green or golden scales; the wing cases long, much broader at the base than the thorax, with fine punctured striae; antennae red, fuscous at the apex; legs red, with dark tarsi and femora. The best treatment would be jarring the beetles off on to tarred boards.

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CURRANT APHIDES.

(*Rhopalosiphum ribis*, Linn., and *Myzus ribis*, Linn.)

All three varieties of currants are often attacked by Aphides or Plant Lice. At least two species are culprits.

During 1901 currant bushes were considerably damaged by them. In some districts the bushes were quite ruined, the leaves turned brown and shrivelled up, and the fruit fell off, the bunches "shanking" in consequence of the abnormal presence of these pests. The rapid increase of the "Plant Lice" was due to a long spell of dry, warm weather, so favourable to the development of these insects, so detrimental to the development of the fruit and health of the bushes. Aphides are usually more or less prevalent on currants, and are always liable under certain



[A. V. D. Rintoul.]

FIG. 165.—CURRANT LEAF WITH BLISTERS SHELTERING APHIS (*R. ribis*).

climatic conditions, such as existed during June 1901, to increase to an injurious extent.

The two currant species mentioned work in a slightly different way. One, *R. ribis*, was at one time thought to produce reddish, reddish-brown, or yellow blister-like galls on the surface of the leaves, whilst *Myzus ribis* often causes the leaves to curl up, especially on the top shoots. Both species are equally difficult to destroy after

they commence to breed in numbers, owing to their being hidden, and more or less protected in the hollows of the blisters and under the curled-up leaves. The galled patches are chiefly noticed on the upper surface of the leaf, where they are blister-like; below they

*[F. Edenden.*

FIG. 163.—RED CURRANT SHOOT WITH DENSE CLUSTER OF CURLED LEAVES
DUE TO APHIS ATTACK.

are concave. In this cavity the aphides live and breed, the area of the diseased patch increases as they develop. The leaves so attacked shrivel away, the fruit often falls owing to loss of sap long before the leaves die. These red blister-like patches are not caused by the aphides. I have frequently during the last few years

found them forming, before any of the aphis had hatched from the eggs. Whether they are fungoid in origin I do not know, but in any case they are not caused, as thought, by the plant lice, which merely shelter beneath them. Neither of these aphides is said to form much "honeydew," hence the diseased appearance of the leaf is often not noticed as being of insect origin during the early stages of the attack, unless an examination has been made of the under surface. Later on "honeydew" becomes abundant, being especially formed by the leaf-curling species; on black currants the "honeydew" often gives a shiny and sticky appearance to the whole bush.

The insects spread chiefly by means of winged generations, which appear every now and then, flying from bush to bush, and there setting up fresh areas of disease. These winged generations may occur as early as the middle of May, but usually not until June. All varieties seem to be attacked.



[A. V. D. Rintoul.]

FIG. 167.—AN APHIS SHOWING TWO YOUNG WITHIN.
(Greatly enlarged.)

(I.) *Rhopalosiphum ribis*, L.—The wingless viviparous female, or "mother-queen," is shiny green, mottled with darker green; legs, honey-tubes, and antennae pale green; eyes, red. In form it is oval and convex, and slightly larger than the following species (II.); the body being $\frac{1}{10}$ inch long. The wingless females are found on the under surface of the leaves and sheltered under the red, orange, and yellow blisters. They appear first of all in April, and occur continuously until July and even August. Every now and then the lice to which they give rise turn into so-called pupæ, which are characterised by rudiments of wings appearing as wing buds.

The pupa is green, and does not, apart from the wing cases,

LIFE-HISTORY AND HABITS.

Although the appearance and habits of the two currant aphides are different, yet their life-histories are very similar.

differ much from the wingless female or larva. The winged viviparous female, which arises from the pupa, is yellowish-green with black head and antennæ; the thorax is black with a yellow band in front; the abdomen is a bright yellowish-green, with dark spots and patches on the back and sides; yellow honey-tubes, swollen towards the apex; legs ochreous, with the joints and the feet black. These winged females fly from bush to bush. In the autumn or late summer males and egg-laying females are formed; the egg-laying female, after being fertilised, deposits a few brown elongated eggs on the last year's growth of a twig just under the broken rind or upon it. Here the eggs remain all the winter. This aphid, besides feeding on the red, black, and white currant, also attacks the gooseberry, and it has been found in the Guelder Rose, the Nipple Wort, and the Sow Thistle. Walker many years ago suggested that this species flew to the lettuce as its second host plant, and from what I have observed I am inclined to think this is correct, for I can detect no difference in the aphides found on lettuce in the late summer, and certainly this species leaves the currants in great numbers in late summer.

(II.) *Myzus ribis*, Linn.—This plant louse can easily be distinguished from the former, with a lens, by its olive, not black, head, and its black honey-tubes and irregularly black ornamented abdomen in the winged female. It occurs from April to August, especially in the black currant and gooseberry, but also on the red currant; it is said to cause blisters similar to (I.). It often causes the leaves at the apex of the shoots to curl and twist up. I have never been able to find any blisters formed by it.

The wingless female, which appears in the spring, is shiny yellowish-green, with dark green mottlings, elongated oval in form, and with curious hairs in front; the honey-tubes and legs are



[A. V. D. Rintoul.

FIG. 168.—CAST SKIN OR EXUVIUM OF AN APHIS.

(Greatly enlarged.)

pale green, and the eyes bright red. The larvæ are pale green. When the leaves lose their sap the larvæ turn to pupæ, and then to winged females. The pupa of this species is shiny yellowish-green, with two brown spots on the back of the head. The winged viviparous female is bright green, with pale olive head, brown thorax with an olive band across it, irregular transverse bands and spots on the abdomen, and four or five dark lateral spots; the deep olive-green to black honey-tubes are cylindrical in form, and the deep green legs have olive feet. Towards July many leave the currants,



FIG. 169.—A KNAPSACK SPRAYER ("FOUR OAKS PATENT") USEFUL IN SPRAYING BUSH FRUIT, ETC.

but some always seem to remain, and give rise to egg-laying females and males, the former depositing their long brown eggs under the exfoliated rind, attaching them to it by a gummy excretion; the eggs hatch in the spring, when they give rise to larvæ, which soon grow into the "mother-queens." The wingless female is smaller than in the former species, being little more than $\frac{1}{2}$ inch long. It also occurs on the gooseberry, and it curls up the leaves and deforms the shoots often to a serious extent.

NATURAL ENEMIES.

The larvæ and adults of the Two-spotted Ladybird are often to be found feeding amongst the colonies of lice, and do inestimable good in keeping them in check. Larvæ of several species of Hover Flies also feed on them, their leech-like green or dull red

larvæ living amongst the lice in the blisters or curled leaves. But in spite of these, great harm results, for they never occur till the damage is mostly done.

PREVENTION AND TREATMENT.

Black currants should be cut very hard in the autumn after an attack, and the stripplings carried away and burnt. By so doing many eggs will be destroyed.

When aphides are present on the bushes it is most important to *spray early in the year*, directly the lice are seen, before the leaves become curled up; the lice can then be far more readily reached by the spray than later in the year.

The most successful wash for these plant lice is dilute paraffin emulsion. This is when a bad attack has taken place, but only slight benefit results when the leaves are once curled. Plain soft soap and quassia is enough if the bushes are washed early.

The wash has to be put on so as to reach the undersides of the leaves.

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THE CURRANT ROOT LOUSE.

(*Schizoneura ulmi*. Linn. = *Schizoneura fodiens*. Buckton.)

Three cases of damage caused by this aphis have been recorded (1, 2 and 6). It is an insect, however, which we must keep under observation, as in one instance the writer found it doing much harm to currants in Kent at Swanley (1). Carpenter (2) has found it in Ireland, and Warburton (6) records it without locality.

The aphis attacks the roots of black and red currants, where it forms an unhealthy galled appearance.

The bluish-grey to white wool, although not abundant as it is in the Woolly Apple Aphis, is sufficient to identify it. Winged forms appear in autumn and pass out of the ground to fresh plants.



[F. E.]

FIG. 170.—CURRANT ROOT LOUSE
ON BLACK CURRANT.

(Note damage at *a* and white
patches.)

these get tough it descends to the roots of currants and gooseberries.

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The pests appear to swarm at times and leave the soil in numbers.

Small galled and split growths may be seen where the aphides have taken up their abode near the stem, and in young stock the plants die under the attack.

Should any pale wool and powder be seen on young currant stocks it is well to have them cleaned before planting, by either washing them in warm soft soap and water, tobacco wash, or fumigating them with hydrocyanic acid gas. Injections of bisulphide of carbon also do good.

This aphis was sent me from Paddock Wood in 1894, where it was found living in the ground and was taken to be the subterranean form of the Woolly Aphis (3). It is to be found attached to the roots and also in earth chambers lined with cottony fibres. Buckton (5) described it as a new species from Haslemere.

This insect has now been shown to be the migrant form of *Schizoneura ulmi* (7), which causes the curled leaves on the elm in spring and summer, and when

THE WHITE WOOLLY CURRANT SCALE.(*Puharinaria vitis* var. *ribesiae*. Signoret.)

This species during the greater part of its existence is one of the most marked of the Coccoidea we find in Great Britain, and cannot well be confounded with any other outdoor species. But during its young scale stages it may be mistaken for the Brown Currant Scale (*Locanum persicae* var. *sarothamni*).

The White Woolly Scale can readily be told during the summer by the presence of a large quantity of white wool, which first appears as a cushion beneath the insect, and which gradually pushes it away from the bark. The white cushions spread out and the fibres become loose and get blown about by every breath of air, threads of extreme fineness being spread from twig to twig and bough to bough like spiders' webbing. Bushes when badly attacked look just as if spiders had spun their webs over them and the bushes had been dusted with lime or white-wash. Figure 171, reproduced from a photograph, shows the appearance of an infested branch. The specimen came from some bushes in Huntingdonshire which were completely covered, as shown in the figure. It is a species readily distributed by the wind and by birds.

The dead dried insect is dull greyish-brown, of a roundish oval form, about $\frac{1}{8}$ to $\frac{1}{6}$ inch long, and like the Brown Currant Scale, with a distinct notch at the posterior end of the body. The edges become curled up and the surface is very convex, and some trace of a keel is seen running down the back, and transverse lines running down from it to the sides. The adult female at the period of parturition is dusky yellow, almost covered with dark brown reticulations which may form indefinite transverse lines; after parturition, dark brown or chocolate-brown to black. At the period of fecundation the female becomes slightly elongate and widened posteriorly; colour dusky yellow, with a median bright line and distinct dark brown reticulations. In the winter the insect fits close to the bark, but by degrees a thick, rather close cushion of wool appears, and gradually lifts one end of the insect up; as this grows it becomes irregular and loose threads get blown from twig to twig and hang about in the air. In this mass of wool the female lays her eggs. The eggs are small, pale, dust-like bodies, which I have found as early as July (1). Newstead finds that the larvae hatch early in June. Some ova I kept for a week; they then gave rise to little, orange, six-legged larvae which moved about actively on the wool and over the twigs; the deep cleft in the caudal

extremity is very noticeable, so also are the two caudal bristles ; in form, the larvæ are roughly oval. The eyes are dark, and the antennæ have distinct long hairs of specific importance. On the antennæ five bristles occur, of which that on the third joint and that on the last are the longest. After five days the surface of the larvæ became keeled and more or less striated, and more convex in form. They showed a distinct aversion to light, both natural and artificial. At the end of ten days the larvæ remained stationary and the skin commenced to harden. Previous to this some of them were more or less covered with little grey woolly granules.

The white nest substance is said by Newstead to be secreted behind and beneath the female's body. By May the females are mature, but the nest is not formed at once, and according to my observations the females do not commence egg-laying until June and continue until July, the larvæ hatching out over a period of six to eight weeks.

When the full complement of eggs is laid the female dies, and her shrivelled body remains behind at one end of the cushion, now loose and irregular.

I have never seen a male scale of this species. Newstead (2) states that it is like the typical male of *Lecanium*.



FIG. 171.—THE WHITE WOOLLY CURRANT SCALE
(*Pulvinaria vitis* var. *ribesiae*).

I have observed this species on the black, red, and white currant. Miss Ormerod (3) records it from the black currant and also from *Ribes sanguineum*, an ornamental species.

Newstead (2) also records it from all three varieties and says it occurs most freely on *R. nigrum*, to which it is often injurious. He records it from Banffshire, Aberdeenshire, Kincardine, Edinburgh City; Arbroath and Berwick-on-Tweed; from Bangor, North Wales; very common in Cheshire and near Liverpool. Mr. Denis Best tells me he has had it in his plantations near Worcester (4). Mr. Moseley records it from Huddersfield.

In the neighbourhood of Paris and in other parts of France, it is not at all an unusual pest on the red currant, and has long been known to be destructive.

The only observations I have made of it in England were on wall bushes in the open, and in all cases the bushes were not in good sunny positions, but were more or less sheltered.

It is strange how suddenly this pest may appear, as seen in the garden in Huntingdonshire. There is no doubt that it is easily wind-borne and equally easily spread by birds, hence its sudden appearance in isolated areas some distance apart. Some of the most interesting notes on it are given by Newstead (2). He records how the young hatch in June and until the first week in July, a period of about twenty-eight days. They are very active for a day or so and then disperse over the plants, ascending to the leaves and young and tender shoots, but rarely fix themselves in such situations. They almost invariably select the hard ripened wood of the previous year's growth. Very little change takes place in the larvæ at first, but by mid July they undergo their first moult. At the end of August another moult takes place. After this the first traces of reticulation show and the distinction of sexes takes place. The males become more elongate and more reticulate than the female. As soon as the elongate form is reached the male enters the puparium stage. By the end of August the male propupal stage is reached, and about seven days later the white caudal filaments of the male are seen to protrude from under the puparium. The males come from under the puparia in mid September and go on appearing until the second week in October. The winged males take a short rapid flight, more like a leap. About the end of September the females effect their third moult. By the third week in October they are nearly mature and closely resemble in colour the bark of the food plant. The insect passes the winter in this stage, and early in March shows signs of growth and secretes honeydew. Towards the end of April the females thicken and the margin of the

body formerly fixed to the branch becomes raised up by the white cushion, and in this pad the eggs are deposited, and the larvæ hatch in June and July.

The great amount of honeydew secreted is very marked.

The treatment is the same as that given in connection with the Brown Currant Scale, p. 230.

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THE BROWN CURRANT SCALE.

(*Lecanium persicæ* var. *sarothamni*. Douglas.)
(*Lecanium ribis*. Fitch.)

The Brown Currant Scale is much more abundant in Great Britain than the former species, and increases with greater rapidity. Moreover, it attacks a larger number of plants. It has been recorded on the raspberry, cotoneaster, *Clematis*, *Crataegus oxyacanthus* and *C. pyracanthus*, *Cytisus scoparius*, *Philadelphus*, *Wistaria chinensis*, *Neillia* (1), on conifers, on euonymus, and on plum (6), but especially on the currant and gooseberry. It has also been found on elms in Denmark (5).

The Brown Currant Scale also occurs in North America, for Fitch describes it under the name *Lecanium ribis*. It is very injurious to the young wood upon which it is often found, sucking out the juices and stunting the growth of the wood. Bushes, etc., affected seldom bear much fruit, and the leaves usually ripen off long before those of healthy bushes. The female is yellowish-brown to rich brown in colour, hemispherical in form, about $\frac{1}{8}$ inch in length; slight transverse markings may be seen at the edge, which when old becomes covered with corrugations, and the edges much contorted. The male is not known in Britain. The larvæ of this scale differ considerably from those of *P. ribesiae*. Their colour is yellowish to pale reddish.

They emit very long delicate glass-like filaments from both ends.

The larvæ wander about freely over the bushes for some time, finally settling upon the young wood, when they soon become flat and

rather sticky, oval in form, pale chestnut to ochreous-brown around the edge, darker in the middle. In six weeks they may assume the mature state, and then the female commences to lay her eggs, the small dust-like eggs being mixed amongst a small quantity of white or creamy threads. During the winter I have found the eggs under



[A. V.:D. Rintoul.]

FIG. 172.—THE BROWN SCALE ON CURRANT (*Lecanium persicæ v. sarothonni*).
(Slightly enlarged.)

the mature scales, but the majority pass the winter in the immature condition as larvae.

Three broods of this insect have been known to occur during the year, rarely two (5). I have found the larvae actively wandering on gooseberry bushes in the middle of November. I have also notes of their occurrence in the same garden in February, April, and again in June and July. Newstead says they are single brooded.

The larvae under observation found in February became mature females by the 2nd of May, and were depositing eggs. These eggs

hatched out in the first week in June, and gave rise to mature females in August, which deposited eggs that hatched out in September. The majority of these were fully developed females by the 20th of October, and from the eggs laid by these there sprung larvae, which I also found on the bushes in November. It thus seems that in Kent, and probably elsewhere, there may be as many as three broods of this Coccid, but usually there is only one brood.

The insect passes the winter in the full grown larval stage, scarcely visible to the naked eye and rarely in the egg stage (5).

These larvae have a distinct reddish hue in the spring.

Unlike the previous species, the larvae are not affected by light.

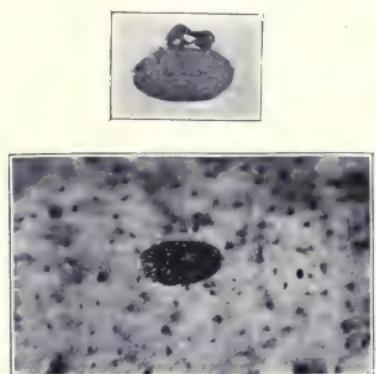


FIG. 173.—YOUNG WINTER FORM OF BROWN CURRANT SCALE. LOWER ONE ALIVE, UPPER KILLED BY PARAFFIN EMULSION.

Curtis (4) refers to this insect as *Lecanium hesperidum*, merely more elongated forms due, according to Newstead, to the exigency of the insects on the twigs.

One noticeable feature in this insect is that very distinct white scars remain for a considerable time on the bushes the dead insects are removed from (Fig. 172).

NATURAL ENEMIES.

Numerous natural enemies prey upon these Currant Coccidae; of these by far the most important are Ladybird Beetles (*Coccinellidae*), but, unfortunately, in Britain we have few, if any, that help us in this respect. The importation of foreign Ladybirds has been undertaken (5 and 6) with the hope of acclimatising some scale-feeding species in this country. Results with the *Vedalia cardinalis* and the Orange Scale (*Icerya purchasi*) in America have been so successful that we

Those observed seemed very fond of wandering about amongst the green algae on the bushes, with which many were covered. The male is quite unknown, the species presumably breeding entirely asexually.

The gooseberry is attacked just as much as the currant, and especially bushes beneath standard fruit trees. This scale has been recorded from most parts of England, and I have observed it in north Wales.

Newstead (1) is of opinion that it is merely a variety of *Lecanium persica* (Geoffroy).

had some hope that similar good results might accrue here. So far this has been a failure.

A few minute *Chalcididae* also feed on these scales, but unfortunately they seem to make little difference in their numbers.

Newstead (1) says the second generation of the White Woolly Scale becomes infested with these minute hymenoptera, which



[F. V. Theobald.]

FIG. 174.—A FUMIGATING BOX FOR BUSH FRUIT.

increased in the third generation under observation to such an extent that 50 per cent. of the Coccids were destroyed. This parasite is known as *Blastothrix sericea* (Dalman).

Many scales are destroyed by the Tits (*Parideæ*), especially by the Blue Tit (*Parus cæruleus*); but as they also help to spread several of these enemies I am afraid that much of the good they do is counterbalanced. Newstead also mentions the Cole Tit (*P. ater*), the Marsh Tit (*P. palustris*), and the Great Tit (*P. major*) as feeding upon them.

I have seen the Long-tailed Tit and also the Golden Crested Wren eating them. Natural enemies in this country are of very little use, and in the case of the Currant Scales seem to do little or no good.

TREATMENT OF CURRANT SCALES.

A hundred and one remedies have been advocated for scale insects, some more or less successful if properly applied. Of patent compounds one need say little, they are too expensive for outdoor use, and often not of much value except on the larvae. But for private greenhouse use no doubt some may be of value, and when used in small quantities will save trouble where money is no object. Three remedies only are of any real service in Scale attack on fruit trees out of doors, namely, (1) caustic alkali wash, (2) Woburn wash, and (3) paraffin emulsions. Fumigation with hydrocyanic acid gas is most successful, but is troublesome to apply out of doors, nevertheless, it might be advisable for Currant and Gooseberry Scales when the attack is very severe (*vide* Fig. 174).

Of the three washes the former is quite successful, clearing the trees and bushes entirely of these two Coccid pests. This wash, which has to be applied in the winter, removes all foreign bodies from the plant. For such scales as the one just mentioned and the White Woolly Currant Scale, no better treatment can be recommended. This wash should be well sprayed over the bushes early in January in currant and gooseberry plantations.

Mr. John Riley of Putley Court found this most effective for the Brown Gooseberry Scale.

Paraffin emulsion should contain up to 6 gallons of the best paraffin per 100 gallons of wash to have much effect. The paraffin jelly recommended for Red Spider on gooseberry may also be used for these insects; so far the best results have been obtained with it and caustic alkali wash.

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- (3) Ormerod, E. A. 'Handbook of Insects Injurious to Orchard and Bush Fruit,' p. 109 (1898). (*Lecanium ribis*. Fitch).
- (4) Curtis, J. Gardeners' Chronicle, p. 516, figs. 1-6 (1843). (*Lecanium hesperidum*).
- (5) Theobald, F. V. Report on Economic Zoology for the year ending April 1st, 1907, p. 50 (1907).
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THE CURRANT GALL MITE.

(Eriophyes ribis. Nalepa.)

The disease caused by this mite is popularly called "Big Bud."

During recent years the mite has become one of the worst pests with which the fruit-grower has to reckon, the damage done is enormous, and no means of extermination has yet been found.

The difficulty experienced in getting rid of the disease is due entirely to the position of the mites inside the buds. Although, thanks to the work of Newstead (1), Lewis (2), and Warburton (3), we know a great deal about the life-history, yet there are still many points upon which we have not yet sufficient knowledge. The minute mite that causes the disease belongs to a family of acari now known as the *Eriophyidae*, formerly as *Phytopidæ*.

Other mites which belong to this family are protected by the bud in a similar way: the Nut Bud Mite (*E. avellanae*, Amerl.), the Birch Mite, *E. rufis* (sub. sp. *typicus*) (Can.) and the Yew Mite (*E. taxi*, Murray), all of which cause the buds to swell in the same way as does *E. ribis* on the black currant. Galls are formed by many of these mites on the leaves of various plants and trees, such, for instance, as the several kinds of small red galls frequently found in numbers on the leaves of the maple and sycamore, and the common "nail galls" of the lime.

They are usually situated on the upper surfaces of the leaves, the aperture being below, and they may be covered inside with a whitish downy substance. Mites belonging to this family attack other fruit



[A. V. D. Rintoul.]

FIG. 175.—BLACK CURRANT SHOOTS, RIGHT ATTACKED BY BUD MITES, LEFT NORMAL.

trees, such as the plum and the pear; the Pear Leaf Blister Mite (*E. pyri*, Scheuten) being very common here, in America, and at the Cape. The gall mite of the currant, like all the rest of the family, is very small.

The disease caused by it has been known in England and Scotland for a long time past, and appears to have been noticed in the neighbourhood of Maidstone quite seventy years ago. At that time it was not known what caused the buds to swell, nor was it apparently considered of much importance. It did a good deal of damage in 1849–1850 in Scotland and probably earlier, but the first authentic record appeared in 1869 (4), when the infestation was prevalent in Yorkshire, and Professor Westwood referred to the cause of the disease as “a peculiar species of acarus” (4).

It is only in the last twenty years the attack has caused serious losses, but it has now spread to such an extent that few plantations are free from infestation in this country and no variety that has been grown any length of time appears to be immune.

The infested buds, which contain thousands of mites, swell to an abnormal size, and though they may eventually open, never do much good and seldom give any fruit of value. None of the supposed remedies are of any value. In one plantation a certain treatment will lessen infestation, while another grower will find that it is a complete failure.

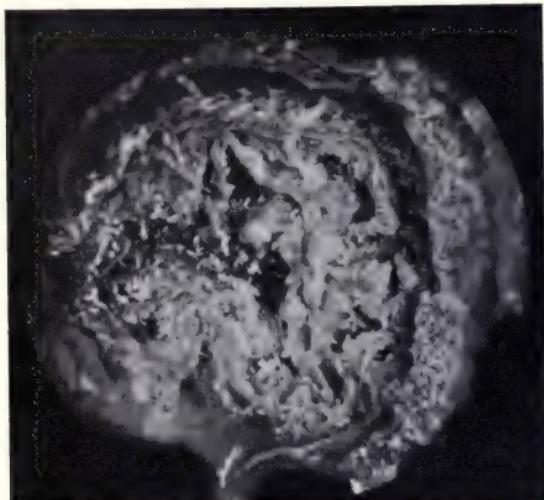
DESCRIPTION OF THE DISEASE.

The appearance of the buds when infested with the Currant Mite can be seen in Fig. 175.

The abnormal growth is due to the mites biting the tissues of the buds. A bush badly diseased will be covered with swollen buds, but when first attacked it is noticeable that sometimes the terminal buds are chiefly infested, and sometimes the basal buds only show signs of disease. In other cases both the terminal and basal buds are free from infestation. The difference between normal and infested buds is usually well marked; the former, as a rule, are conical and look clean and healthy; while the latter, presenting a somewhat mealy and bloated appearance, are more or less globular in shape (Fig. 175).

The buds attacked do not always burst open, but they turn brown during the summer. These dead dried buds will remain on the bushes a long time. On opening a diseased bud it will be found that the parts within are distorted and pale in colour, owing to the extraction of the juices by the mites, whose presence will only be

detected by the appearance of a faint white powder. The fact that a



[W. H. Hammond.

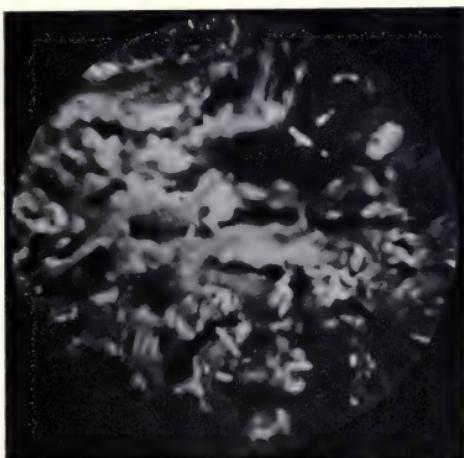
FIG. 176.—SECTION OF BIG BUD, SHOWING COUNTLESS MITES AS A
SMALL WHITE DUST.
(Enlarged.)

bud is not swollen must not be taken to mean that it is mite free. A few mites may often be found in a normal bud, having just migrated there. Then, as they increase, the bud commences to swell. Each diseased bud contains thousands of mites, which are very prolific. Eggs and young are all found mixed up with the adults.

DESCRIPTION OF THE MITE.

The mite (Fig. 178) is semi-transparent and shiny, narrowly elongate and cylindrical in shape, in length nearly $\frac{1}{100}$ inch.

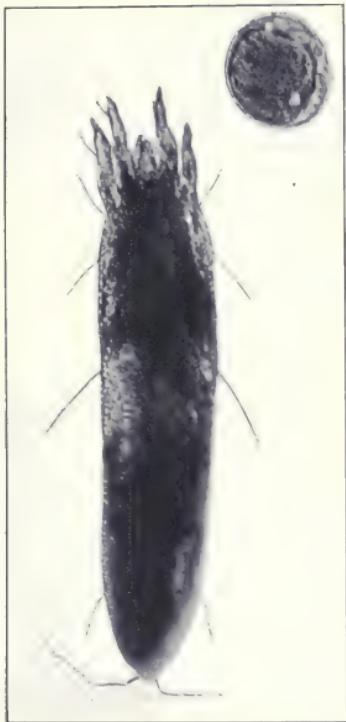
The body, which is white or pale yellowish-green in colour, is marked



[W. H. Hammond.

FIG. 177.—SECTION OF BIG BUD, SHOWING DENSE MASS
OF MITES.
(Greatly enlarged.)

with a series of from 60 to 70 transverse rings, furnished with regular rows of circular projecting processes, only at the sides of the body can these be recognised as projections. There are four legs placed at the anterior end of the body, two on each side of the head. A small bristle appears on the underside of the second segment; a very long bristle extends from the upper side of the third segment, a shorter one from the upper side of the fourth, while two bristles arise from the terminal segment, a short one from the inner side and a long one from the outer side near the base; this terminal segment, on the upper side near the end, is furnished with a strong, blunt claw, and at the extremity with a shorter process, with five bristles extending from each side of it.



[F. Edenden.]

FIG. 178.
THE CurrANT BUD MITE AND OVUM.
(Greatly enlarged.)

adapted for biting and sucking. The cephalo-thorax is protected above by a triangular shield marked with longitudinal furrows. That portion of the body below the caudal pair of bristles acts as a sucker, and is used by the mites as a means of attachment to the food plant while they wave their bodies and legs in the air (a performance which they go through when any diseased bud is opened, one mite being capable of thus holding up several of its companions).

There are five pairs of bristles on the body, the first of which are placed on the under surface midway between the base of the legs and the second pair of bristles; these latter are much longer and situated slightly anterior to the middle of the body. The next pair are very short and are placed on the ventral side of the body; another comparatively short but slightly longer pair are placed near the posterior extremity, on the ventral side; and the fifth pair, which are the longest of all, arise from just behind the anal extremity. The head ends in a blunt, snout-like projection including the mouth parts, which consist of a pair of maxillæ and a pair of mandibles, the mouth being

The adult stage is reached after a series of moults, but the exact number of these has not been ascertained.

The different stages vary to some extent in shape, some being slightly longer and narrower than others, while many are very short and stout, presenting a swollen appearance towards the head. They seem capable of contraction and expansion, and this partly accounts for the difference in form. The eggs (Fig. 178) are very large when compared with the size of the mite; they are pale greenish in colour and glassy in appearance, furnished with a strong chitinous covering which becomes irregular in shape (according to Lewis) just previous to the hatching of the mites.

LIFE-HISTORY AND HABITS.

Writing in the S. E. Agricultural College Journal, Mr. Lewis said: "The life-history of the mite does not up to the present seem to have been quite satisfactorily determined. The question as to what happens to the mite when the buds burst in the spring and summer has not been satisfactorily answered in a manner to account for the continuance of infestation in certain cases, where drastic measures have been resorted to with a view to extermination. The fact that the whole of the diseased bush above ground can be cut down and destroyed, and the root stock also subjected to treatment without result (all the bushes in a diseased plantation being treated alike), seems to show that the mites, or their eggs, or both, must be able to retain their vitality for a considerable period in the soil. I have, however, never yet found any mites living for any length of time in the soil taken from around infested bushes, after subjecting samples to careful microscopical examination. The minute size of the mite makes it a very easy matter to pass it over, even after exhaustive search, and this applies as much or more to the eggs also, but if living mites continued to be present in any numbers, some at least ought to have been found in the numerous samples of soil taken. The margin for error is, however, too great in such a case for a reliable and definite result to be obtained." Repeated examinations have definitely proved that eggs may be present in the buds all the year round, but more numerous at some seasons than others, and regulated in numbers to a large extent by temperature. There are fewer in December and January (especially in the latter month), according to Lewis and my own observations, than at any other time during the year. The fact of the presence of the eggs in the buds throughout the year is a very important one, and has been questioned

in some quarters; but during the winter of 1897 (6) Lewis examined infested buds at very frequent intervals, also in 1899, and always found a certain number of eggs.

The mites may be found outside the buds from early March onwards for some months, but the main number are to be seen in April. They may then be seen moving over the burst buds, at their base, and you may find them on the blossom strigs and in the blossoms.

Mr. C. Warburton, in a paper read before the Linnean Society, mentioned that the mites hold on by their anal sucker and wave their legs in the air; he further noticed a point of some importance, hitherto undetected, namely, that the mites possess the power of leaping off the plant into the air, and he assumes that they do this

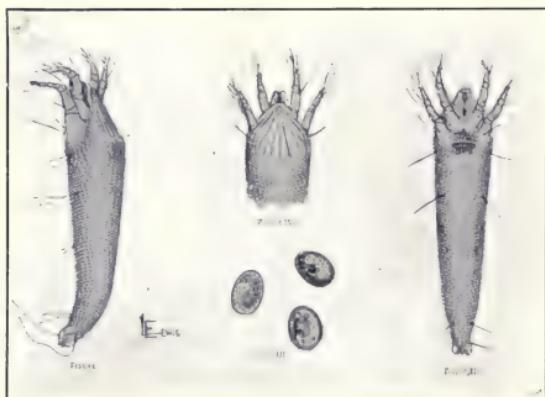


FIG. 179.—THE CURRANT BUD MITE (*Eriophyes ribis*) AND OVA.
(From Lewis.)

in order to attach themselves to passing insects, and in that way get distributed, to a certain extent, from one plantation to another.

In the beginning of June, the mites have been seen congregated round the young buds, between the main stem and the basal portion of the leaf petioles. By the end of the month many infested buds which have not burst dry up, and the mites apparently die in them. Throughout July many old buds which have not dried contain both mites and eggs, and the latter are always plentiful from the beginning of March. It is not until towards the end of July that the presence of the mites in the newly-formed buds may be noticed. On the 10th of August buds not more than $\frac{1}{16}$ inch in length were found by Lewis to contain mites, and many of these buds contained eggs by the middle of the month. In the

middle of September many buds are swollen, especially in the vicinity of the dried-up buds which have burst, and many mites and eggs are present in each. Beneath the bud scales Lewis found, in several cases, about half a dozen mites entirely red in colour, which was probably due to their food, as the scales on which the mites were situated were reddish in tint. On the 24th of September he found a few buds with scales reddish in colour contained red mites, but these were always near the outside of the bud ; in one case he found two red mites near the centre of a bud. The most important points seem to be that from the middle of April, or earlier, to the end of May, or later, according to season and situation of the bushes, as a succession of swollen buds burst, mites are to be found crawling outside the buds, on the stems, flowers, and petioles of the leaves, or congregated between the base of the leaf petiole and the main stem ; that they are afterwards found in the new buds as soon as they begin to grow ; and that, as far as can be at present ascertained, they do not appear to be able to live for any length of time in the soil. I have also found them sheltering under the rind of the "snags" of cut back bushes. At present we are quite unable to say what happens to many of them which escape from the swollen buds before the young buds are formed, and also how it is that when a bush is cut right back they start on the young shoots. The probability is that many can and do live for a time under the rind and in the ground, and then come out and invade the young buds.

VARIETIES CHIEFLY ATTACKED.

Most varieties are attacked, some worse, however, than others ; the Baldwin suffers most, then Black Naples and Black Dutch and Lee's Prolific.

Carter's Champion was considered to enjoy immunity in some districts in Kent, but is now very badly diseased.

The old varieties of black currant were never found to be attacked in Kent until the last five years. Now some of the worst cases may be seen in cottage gardens when they grow. The Boskoop Giant is to some extent resistant, owing to its very strong growth. The French currant is at present only slightly attacked in this country and is worth trying, but will probably share the same fate as others.

MEANS BY WHICH THE DISEASE IS SPREAD.

The ways in which the mite is carried from bush to bush and plantation to plantation are many.

The wind, the clothes of the men working among diseased bushes and the soil carried away on their boots are certain means. Ladybird beetles feeding on aphis on the currants carry the acari with them. One of the most prevalent means is distribution by the Red Bee (*Andrena rufa*) and the Hive Bee (*Apis mellifica*), both of which visit the bushes when in blossom.

The great cause of the increased area over which the attack has spread is to be looked for in the propagation of diseased cuttings from infested stock. When considering this point, it should be noticed that the old varieties of black currant were rarely, if ever, attacked, and cuttings were seldom taken from them, while one of the commonest varieties, and the one that was very largely propagated, namely, the Baldwin, is also the kind that is the worst infested. Owing to the prevalence of disease, growers have given up the Baldwin to some extent for other varieties, such as Black Naples and Lee's Prolific, with the result that these are now, in many districts, as much infested as the Baldwin variety. Before the attack was so well known as is the case at the present time, the sending out of diseased stock from nurseries was to a large extent responsible for the spread of infestation.

Records show that cuttings have been taken from infested bushes solely on account of the large size of the buds, which was taken as an indication of extra strength and vigour.

I am quite sure from some observations made that the mite may be spread, from an infested to a clean plantation, by means of the baskets used in picking the fruit.

Some of the agents of distribution mentioned above, especially insects, would probably form the natural means whereby the disease is spread, and if this distribution had been dependent on them alone, the disease would not have obtained such a strong hold as is now the case, and would not have spread to anything like its present extent.

The grower and the nurseryman, however, by means of propagation from diseased stock, have done more to cause the loss which they now experience than all the natural agents put together. The necessity of obtaining clean cuttings in the first place cannot be too strongly insisted upon, and when obtained they should be put out on fresh ground not previously planted with black currants, situated as far away as possible from any infested plantation. It is possible also that birds may help to carry the pest from place to place over wide areas.

SPREAD OF INFESTATION IN A PLANTATION.

With regard to the rapidity with which the disease spreads from bush to bush in a plantation, Lewis made the following observations at Wye. In a plantation containing about a thousand bushes (Baldwin variety) there was here and there a bush having one or perhaps two big buds upon it, but never more than two. In January 1901, he attached labels to these infested bushes, showing the number of swollen buds and their position on the plant. In the following December he found that the bushes which had been labelled were covered with big bud. In no instance, however, had the unlabelled bushes surrounding them been attacked.* From this it would seem that the infestation in a plantation does not spread rapidly from plant to plant. There is, however, every reason to believe, from direct experiment, that when bushes become covered with big bud, many of the mites in the spring will be compelled to migrate, and the attack may then be spread from one badly infested bush to all the bushes round it. Once these have been attacked, even if only to the extent of one bud (and this is what usually happens, as comparatively few mites out of the thousands compelled to migrate will reach a congenial position), then that bush will be covered with big bud by the end of the following season, and the mites will migrate from it to the surrounding bushes in the ensuing spring. This emphasises the necessity and great importance of pulling up and burning any infested bush in a plantation comparatively free, and this should be done *immediately* any big bud is detected on a bush.

This, of course, only applies to where *one* or *two* bushes show signs of attack.

In order to prove that the mites migrate from bushes that are covered with big bud, and to find out how rapidly the infestation is carried to surrounding bushes, Lewis tried the following experiment at Wye.

In an isolated position far removed from any possible outside source of infestation, three very badly diseased bushes were planted and surrounded by young healthy plants known to be entirely free from disease. These were all surrounded by wire-netting to prevent them from being disturbed in any way and to exclude birds.

They were put in in December 1900, and in the following November the young bushes, with two exceptions, were infested with big bud, two or three big buds being present on each.

* These bushes were four years old, planted ten feet between the rows and three feet apart in the rows.

These observations of Lewis, the most complete yet made on this pest, all tend to show how necessary it is to grub any bushes showing signs of bad infestation and the hand-picking of those showing traces of the disease.

A PECULIAR ATTACK OF THE BIG BUD MITE ON RED CURRANTS.

A very curious attack of the big bud mite was recorded by Mr.



[A. V. D. Rintonl.

FIG. 180.—ABNORMAL ATTACK OF BIG BUD ON RED CURRANTS.

Thomas Edwards of Grange, Gillingham, Kent, in November 1900, on red currant bushes. This was the second he had found (7).

Later Mr. Edwards wrote me that he had had such a bad attack of big bud in the black currants that he had destroyed them by burning. The attacked red currants were raised by himself and not imported.

The resulting disease caused by the mites presented such very marked features that I decided to send the acari to Dr. Nalepa, of Vienna, who reported that they were undoubtedly the *Eriophyes ribis*, Nalepa, which causes the "big bud" in black currants.

The mites produced a dense growth of buds, every here and there, which were found to be teeming with them. At the same time the shoots bearing the attacked buds were abnormally swollen, many twice the thickness of normal ones.

Although the buds were teeming with mites, no trace of eggs could be found. The dense mass of buds occurred in smaller areas all up the stem, as shown in the photograph.

This new working of the gall mite is certainly far more serious in the red currant than in the black, and growers cannot do better than burn all bushes in which it appears, on the first sign of disease, as was done in this case. Carpenter also records (12) this pest in red currants in Ireland, but says, "the presence on that kind of fruit seems to have no serious effect."

NATURAL ENEMIES.

So far no natural enemies of any account have been found. The following may, however, be mentioned.

A TORTRIX (*Tortrix podana*, Scop.) FEEDING IN BIG BUD.

Mr. E. Leonard Gill, writing from Barras Bridge, Newcastle-upon-Tyne, on the 29th of May, 1906, sent twigs of black currants badly attacked with "big bud." He wrote as follows:—"I sent samples of black currant twigs which have been damaged by some insect. The bushes in this neighbourhood are being damaged a good deal in this way this year. The caterpillars in the samples appear to be those of a Tortrix, possibly an *Antithesia*," etc.

In early June, Mr. Gill wrote saying that there did not appear much hope that the caterpillar was doing much to check the increase of the mites, but that he was obtaining evidence to bear on the subject.

On the 19th of June, Mr. Gill wrote: "I have been unable to obtain a proper supply of 'big buds' to feed the Tortrix on, and they seem to regard the 'big buds' very definitely as their proper food. Two of them have already spun up in leaves, and it is possible that these will emerge in due course."

Finally, Mr. Gill wrote on the 21st of August that he had bred *Lozotania fulvana* (*pyrastrana* or *podana*), but that he does not see that they will have any definite effect in checking the disease (8).

A number of this Tortrix have been since bred from the "big buds," but at present there is no evidence to show that they do any good. None have been found in clean buds.

With regard to the presence in diseased buds of other mites and

of insects which may possibly prey upon *E. ribis*, Lewis mentioned a dipterous larva as being commonly met with. This larva was often seen in "big buds," but it fed slowly and the mites increased so rapidly that it did no good. Concerning this larva, which is the maggot stage of a two-winged fly, the late Miss Ormerod mentioned some years ago (9) that "there appears to be no doubt that it was feeding upon the Phytopti."

Lewis also says: "I have noted certain species of Thrips, and various insects belonging to the *Collembola*, a sub-order of the *Aptera*, but though many of the former are predaceous and are known to feed on Cureulio eggs and *Phylloxera* (10), the latter, so far as I know, feed only on refuse animal and vegetable matter, and were doubtless chance visitors from the old diseased dried-up buds, filled with the remains of the gall mites originally infesting them."

"Acari are numerous in the diseased buds, among those met with being a species of *Tetranychus* closely related to the red spider, and two species of the genera *Tyroglyphus* and *Scutus*; the former genus belonging to the family of the cheese mites, and the latter to the *Gamasidae*, a family of mites which are parasitic on insects. I have often found representatives of these two genera in the buds of the hazel infested with *E. avellana*, and Mr. Theobald quotes them as being found in buds attacked by the yew mite. I have often noticed outside the diseased buds numbers of a species of *Bryobia*."

Lewis also considers that beetle mites (*Oribatidae*) devour many of the Eriophyes when they are migrating, and states that "they have also been noticed devouring the galled patches on plum leaves attacked by the plum mite." None of the above-mentioned mites and insects can prey upon *E. ribis* to any great extent, as they produce no lessening in the spread of this disease.

Some small *Chalcididae* have also been bred from this Eriophyes, and Collinge (13) records the Seven-spotted Ladybird (*Coccinella 7-punctata*) as an enemy.

PREVENTION AND TREATMENT.

So much has been said and written on this subject that it is impossible to enter into all the various supposed remedies.

At present all that can be said is that we know of no means of destroying this serious pest. Several things, however, can be done to check it:—

(1) *Cultivation from clean stock* is first to be borne in mind. Clean stock can be obtained, especially from abroad. The French varieties are, we may say, free from this mite, and, moreover,

according to many growers, resist the attack. A few, on the other hand, find them to be attacked. In one or two places I have seen the French as bad as any other variety, but such is very unusual. Clean stock can be got here and there in Britain, notably in Northumberland, parts of Kent, and in parts of Hampshire. I have seen many clean plantations dotted over the country.

It is important that cultivation should be made from this clean stock.*

(2) *Disinfection of cuttings.* Cuttings can be safely disinfected by immersing them in water for some days before setting. Cold water has been found quite successful if left in it for a couple of days.

A better treatment was found by Pickering, namely, of immersing the material in water at 115° F. for ten minutes before planting (14).

(3) *Immune Stock.* No such thing exists, but we may well bear in mind that certain varieties do resist this disease. Of all, the Boskoop-Giant is best; this is not due to any actual immunity, but to strong growth. The French must also be duly considered.

The old Kent Cottage currant was found to resist this disease for many years, but now it is as bad as any other.

A strong growing variety is that which will withstand it longest, and that is all that is needed, for in such a paying crop we can well afford to grub and replant when the disease has got too strong a hold upon the bushes.

(4) *Hand-picking.* Nothing is better than this. If a plantation is gone over twice a year and the swollen buds picked into sacks and burnt the pest can be well kept in hand.

From repeated observations I have found that the bud above and the bud below a swollen one contains mites, and thus in hand-picking it is well to take one off above and below the diseased one.

(5) *Dusting with Lime and Sulphur.* The writer has never found this of the least benefit, but two large growers who can be relied upon have found it beneficial. On the other hand, we must note the record of hundreds of others, who have found little or no use in this treatment.

It is mentioned here in case anyone cares to try it, but from all the reports sent me and from personal experience it cannot be recommended, as too frequently it means useless expenditure of money.

The treatment as advised by Mr. Collinge is as follows:—Dust

* Most unfortunately the importation of French currants is prohibited by the Board of Agriculture, as it is said to be a host of the American Gooseberry Mildew.

with one part of finely ground quicklime and two parts of sulphur. This requires to be done three times, in spring and early summer, at intervals of a fortnight.

It is important that the plants be moist, if not so they must be sprayed with plain water first.

Considerable damage is often done by this treatment, owing to the scorching of the leaves and shanking off of the fruit.

Nothing further need be said on this subject; all other methods, such as fumigation, spraying and greasing the bushes (a thoroughly unpractical method), are of little or no value.

The grower must rely on hand-picking, the growing of strong varieties, grubbing and replanting with clean stock when the plantation is so badly infested that it becomes unproductive.

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DAMSON.

LIST OF INSECTS, ETC., INJURIOUS TO THE DAMSON.

A. LEPIDOPTERA.

WINTER MOTH (*Cheimatobia brumata*). Foliage, p. 50.

MARCH MOTH (*Anisopteryx oesularia*). Foliage, p. 61.

B. HEMIPTERA.

HOP-DAMSON APHIS (*Phorodon humuli* v. *malaheb.* Fonse.). Foliage, p. 247.

YELLOW LEAF HOPPER (*Chlorita viridula*. Fall.). Foliage (*vide Plum*).

C. ACARINA.

LEAF GALL MITE (*Eriophyes padi*. Nalepa). Rare on Damson. Leafage, p. 254.

THE HOP-DAMSON APHIS.

(*Phorodon humuli* var. *malaheb.* Fonse.)

This aphis, which is so well known in hop districts, is not only a serious pest of the hop grower, for the orchardist also suffers from its ravages.

The damson is frequently attacked to a serious extent, just at the time it is in the most delicate stage, when the young leaves are unfolding.

LIFE-HISTORY AND HABITS.

If we examine damsons in the orchards near hop gardens during the months of November, December, January, February and March, we shall find in the forks of the buds and twigs small shiny black eggs—the ova of this aphis. As many as ten may be crammed into one axil. They are attached somewhat firmly to the rind, or even to one another. In form they are spindle-shaped, slightly curved beneath, with a comparatively soft shell of a shiny black colour, and resemble other aphid eggs; in fact, on the same trees, and almost exactly alike, may now and then be found the ova of the Plum Aphid (*Aphis pruni*), but the latter are often deposited just under the bud, whereas those of *humuli* are laid in the axils of the

small twigs and buds. In this position they remain until the buds of the damson burst in spring. The earliest date I have noticed them hatch out is the 29th of March. That is later than the hatching of the true plum aphid.

Not only are these ova laid on the damsons and now and then plums, but also in numbers on the sloe; in fact, the damson and sloe are most affected. During the autumn vast swarms of the hop aphid cover the leaves of all prunes, yet but very few eggs are detected on plum trees and greengage, whilst the damsons are literally covered. If damsons and sloes exist in the neighbourhood they are used as winter egg quarters in preference to any other prunes. The planting of damsons without any necessary checks has been a means of increase for the hop aphid. On these trees the ova hatch out in spring into



[F. Edenden.]

FIG. 181.—HEAD OF VIVIPAROUS FEMALE OF THE HOP-DAMSON APHIS (*Phorodon humuli*).
(Greatly enlarged.)

lice, which speedily grow into wingless and viviparous females; these are sometimes spoken of as "queen—" or "stem-mothers." These wingless females produce living young like themselves, and suck out the sap of the young damson leaves, often causing untold damage, and the blossom may suffer. They can at once be told from the Plum Aphid (*A. pruni*), by the small processes on the head shown in the figures. Some authorities have considered this prune-hop aphid a distinct variety, known as variety *malaherb*; there is no reason for giving it another name, it is the same aphid, although the antennal swellings are not so developed on the damson as when it is on the hops. On the prunes there seem to be normally

three generations, but there may be only two, or as many as five, depending upon the food.

The damson form assumes wings, and then leaves the first plant host and betakes itself to the hops. This migrating form is a winged viviparous female with small cephalic and antennal processes. They appear on the hops from May onwards. In 1897 the migration lasted from the 25th of May to the 14th of June—a "climatic check" came in between. In 1899 they did not leave the damson until the 20th of June. From the few observations I have made, I find even approximate dates difficult to give. All that we can definitely say is that somewhere about the end of May to the second week in June the aphides leave the damsons, sloes, and other prunes, and fly off to the hops. These winged migratory forms are viviparous females, which at once commence to bring forth living young, the so-called *lice*. Within ten days of birth these lice become the apterous viviparous females, and produce other lice, and so on for several generations. These lice and apterous females have not only more distinct frontal tubercles, but also a distinct process on each basal joint of the antennæ. Sometimes these viviparous wingless females or lice may turn into pupæ, and so another brood of winged females in the summer, which fly from hop bine to bine and garden to garden. This, I noticed in 1897, took place on a number of bines where lice were in great abundance early in August. These wingless and sometimes winged viviparous females go on until the autumn, when they nearly all enter the pupal stage, become winged, and leave the hops. The dates of this migration vary. In 1896 I noticed them moving on the 20th of September, and again on the 22nd. In 1899, the first migration in the neighbourhood of Ashford took place on the 18th of September, when the air was laden with them; another large migration took place on the 28th of the same month; whilst



[W. H. Hammond.

FIG. 181a.—OVA OF THE HOP-DAMSON APHIS
(*Phorodon humuli*).
(Slightly enlarged.)

in 1898 many females were on the wing as late as the 16th of October.

These migrating viviparous females fly back to damson and sloe, but, as stated before, in smaller numbers to other prunes. I have also seen them giving rise to the next generation on hawthorn hedges and cherry, but these latter never survived. This migration, as far as observations go, takes place chiefly on still days and when the air is warm. They do not seem to fly instinctively to the damson, but rather are carried there by chance. Oaks, ash and all manner of trees get covered by the migrants, the majority of which could never reach the prunes, and even where a large damson plantation adjoined a hop garden, thousands of the aphides were



[F. Edenden.]

FIG. 182.—WINGLESS FEMALES OF THE HOP-DAMSON APHIS.
(Greatly enlarged.)

moving in an opposite direction. The direction of their migration is, it seems, dependent on currents of air—hence hundreds of thousands die, for the ovigerous females do not seem to be able to live on other trees than prunes.

These migrants, a few hours after they have become located on their proper plant, produce a few lice, which grow into oviparous wingless females. It seems that these winged return-migrants produce very few lice, usually only four are produced by each winged female, but a few give rise to five or six. The embryos can easily be seen in the parent's body.

About this time winged males also make their appearance. These males are smaller than the winged females. They come

partly from the produce of the migrants from the hops and rarely from the hops themselves—the winged males appearing some ten days later than the winged female migrants. These males fertilise the oviparous wingless females, and may be found in numbers *in copula* on the prunes. In about two days after copulation the females deposit one or more greenish eggs, which soon become black. They commence ovipositing in October in small numbers; great numbers of eggs have been observed by the 22nd, oviposition ceasing on the 8th of November. Here the eggs remain all the winter, starting fresh in the spring, as previously narrated.

Phorodon humuli can, however, carry on its existence in another way. On two occasions aphides have been found on the hop-shoots early in the year (April). During the winters of '96, '98, and '99, I frequently searched for *humuli* in the hop-hills and on broken bine, both as eggs and aphides. In 1898, in February, I found two wingless viviparous females in the hills. It appears, therefore, that continuity may be carried on during the winter in that way as well as in the egg stage on prunes. Several observers have told me that they notice lice on the hops early in the year, and probably these have wintered in the hills, and commence to give rise to young as soon as the weather becomes favourable. In experiments conducted at Stoke Edith in 1884, it was found that where the hills were dressed no early lice appeared, but the rest of the garden was infested.

It is thus pretty clear that this *aphis* lives in two ways during the winter—upon the prunes in the egg stage, and a few in the hop-hills and other shelter, and thus living entirely upon the hop; damage being done to both host plants.

DESCRIPTION OF THE APHIS.

(1) *Apterous Viviparous Female.* On prunes, oval in form; bright to yellowish-green, with a central dorsal deep green line, and a deep green jagged lateral stripe on each side. The frontal tubercles distinct. Eyes, reddish. Legs and antennæ, apple green. Length



FIG. 183.—OVIPAROUS FEMALE OF THE HOP-DAMSON APHIS FROM DAMSON.
(Greatly enlarged.)

from 1 to $2\frac{1}{2}$ mm. No distinct prominence on the first antennal joint.

(2) *Winged Viviparous or First Migrant Female.* On hops, coming from prunes. Apple-green, with dark blackish-brown head, thoracic lobes and spots under the wings. Abdomen also with dark brown transverse bands, and three or four blackish spots on each side. Legs, green and black. Eyes, reddish-brown. In this female the first antennal joint has a small projection.

(3) *Apterous Viviparous Female.* On hops. Elongate oval, pale green, smaller than wingless female on prune. Body semi-transparent and shiny. From one to three dark green lines down the back, the lateral ones broken. Eyes, red. Frontal tubercles distinct, first antennal segments with large process. Length from $1\frac{1}{2}$ mm.

(4) *Second Winged Viviparous Female.* This winged female that flies back to the prune is larger than the one that left, the wing expanse being between 6 and 7 mm., and the body length from $1\frac{1}{2}$ to 2 mm. Colour, pale green. Head and prothorax, dark brown. Thoracic lobes, brown, and one or two brown transverse bars on the abdomen; four blackish spots on each side; anal plate also dark brown. Eyes, red. Antennæ, green at base, brown at tips. Stigma of wing, green; base of wing, yellowish. Frontal tubercles not well developed.

(5) *Origerous Wingless Female.* On prunes. At first almost white, but becoming olive, slightly mottled before egg-laying. Small and somewhat flattened. Frontal tubercles well developed, and also antennal processes.

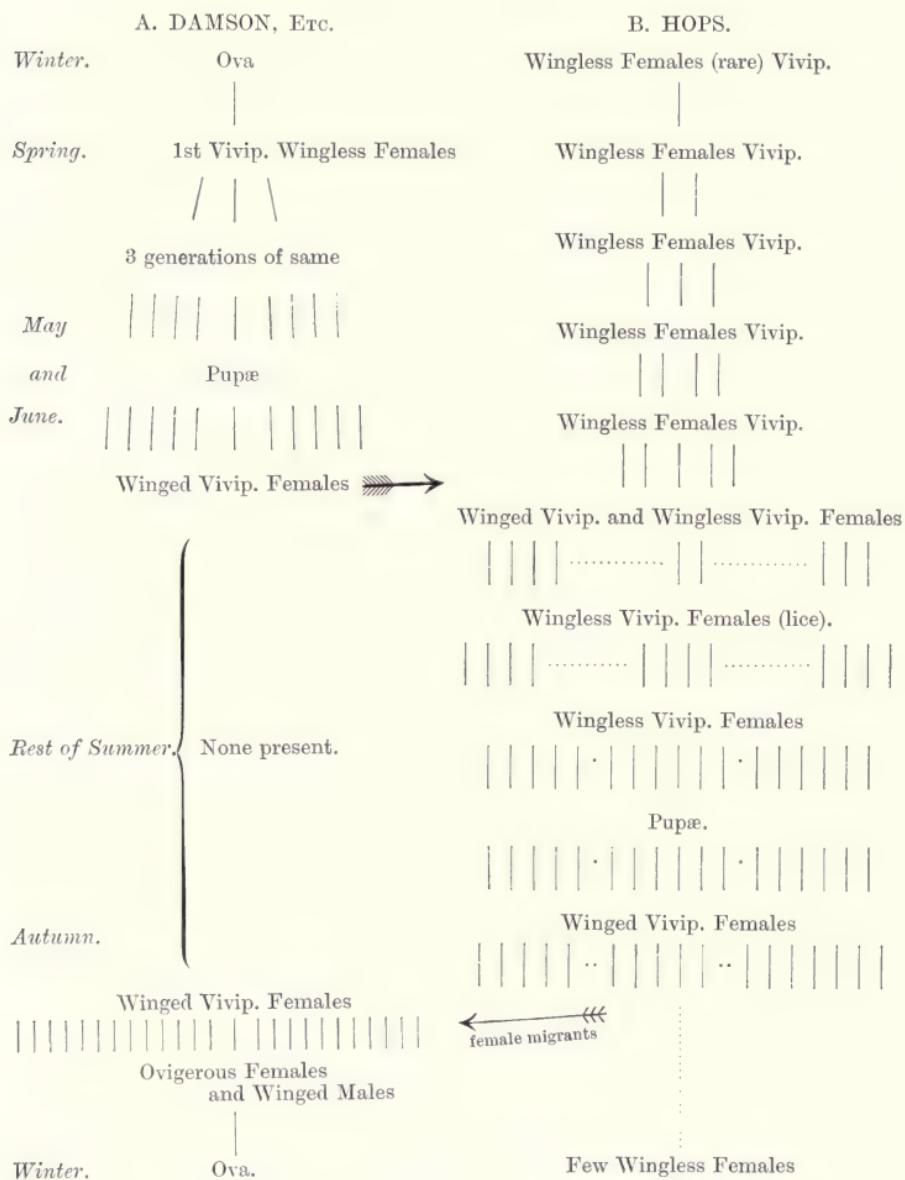
(6) *Winged Male.* Pale green; thoracic lobes and scutellum, deep olive-brown. Eyes, red. Wings similar to female. Antennæ much longer than body. Frontal tubercles small; antennal processes moderate.

The *pupa* are greenish-yellow and pilose. Eyes as usual, red. Wing buds tipped with pale brown. Tubercles developed.

PREVENTION AND TREATMENT.

The cultivation of hops in the neighbourhood of damsons is decidedly giving this destructive insect undue advantages of increasing. But that practice may be made to work in an advantageous way, if growers wash their damsons early, when lice are seen upon them, and so kill the insect before its advent on the hops. Considerable harm is done to the prunes by these lice, and thus washing is doubly beneficial. The majority of eggs hatch out by

TABLE SHOWING LIFE-HISTORY OF HOP APHIS.



the end of April, so that that would be the best time to wash with any good aphicide. Autumn washing, as soon as the damsons are gathered, would doubtless do much good, but spring washing, when the lice are all out, would tend largely to decrease this pest and save the loss to the damsons. Of course, we shall always have attack coming from wild prunes to the hops, and even a few from direct development on the hops. Lime, salt and waterglass wash stops the eggs hatching.

It will always be impossible to entirely prevent this pest, as it breeds on wild prunes and thence migrates to the hops, and so back, perchance, to usually uninfested damsons. The eradication of sloe and bullace should, of course, be aimed at near either hop or fruit plantations, but at present this seems impossible.

We can do much to prevent damage in damsons, however, by washing them, just before the buds burst, with the lime and salt wash for a couple of years, for this undoubtedly prevents the young from escaping from the egg-shells, just as it does with the plum aphis.

Should this not have been done, if the trees are seen to be badly infested, a good spraying with tobacco wash should be given them. If this is considered too expensive, then, in the place of it, use the soft soap and quassia wash.

THE SLOE AND DAMSON GALL MITE.

(*Eriophyes padii*. Nalepa.)

The leaves of the sloes in the hedges and also of the wild bullace are frequently seen to have the edges of the leaves galled. These marginal galls are paler than the leaf, rather roughened and often velvety in texture. These galls are formed by a mite formerly known as *Phytophtus attenuatus* of Bremi (1).

I have now and then found it on the damson, but am not aware of it having done any appreciable damage. Nalepa (2) mentions it on *Prunus padus*, and Houard (3) on *Prunus insititia*, *Prunus domesticus*, *Prunus spinosus*, *Amygdalus communis* and also *Prunus padus*.

I have notes of it on damsons in Kent, Surrey and Devon.

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- (3) Houard, C. 'Les Zoocécidies des Plantes d'Europe,' p. 556 (1908).

FIG.

INSECTS, ETC., INJURIOUS TO THE FIG.

HEMIPTERA.

MEALY BUGS (*Dactylopius citri* and *D. longispinus*). Axils of leaves, etc., p. 483.

PEACH SCALE (*Lecanium persicæ*. Geoff.). Wood and leaves, p. 321.

THE SOFT BROWN SCALE (*Lecanium hesperidum*. Linn.), p. 257.

NARROW FIG SCALE (*Lepidosaphes ficus*. Sig.), p. 258.

CAMELLIA SCALE (*Aspidiotus camelliae*. Sig.), p. 258.

LONG BLACK SCALE (*Ischnaspis filiformis*. Doug.). Foliage and stem, p. 259.

THYSANOPTERA.

THUNDER FLY OR THrips (*Thrips sp.*). Foliage, p. 352.

ACARINA.

RED SPIDER (*Tetranychus telarius*). Foliage, pp. 397, 488.

No insects seem to feed upon the fig in the open in this country, but under glass it is frequently attacked by Red Spider and Thrips. More rarely we find Mealy Bugs and the Scale insects dealt with here.

THE SOFT BROWN SCALE.

(*Lecanium hesperidum*. Linnaeus.)

This species I have found twice on figs in this country. It is common under glass, and attacks a great number of plants, and also occurs out of doors on ivy, myrtle, holly and bay.

The female when full grown is about $\frac{1}{7}$ inch long; the colour varies from yellow, when young, to brown when adult. The young female is flattish, and has often brown markings on the yellow ground, forming an irregular network, which coalesces as the insect grows. After death the insect becomes pale brown. In form, it is convex, and there is a trace of a central ridge; after death the edges become crinkled. The female is viviparous. The male is very uncommon. The puparium of the male is said by Newstead to be glossy.

This species may easily be told by the quantity of honeydew it secretes, and the consequent growth of black smut fungus around it.

In this insect no true scale is formed, what is called the scale is merely the hardened skin of the female.

It will breed in this country very rapidly under glass, and it is important to kill it directly it is seen on the wood of the fig, before it gets on to the leaves.

THE CAMELLIA SCALE.

(*Aspidiotus camelliae*. Signoret.)

This limpet-shaped scale is often very common on cultivated figs, and unless kept in hand will spread on them to a dangerous extent.

The female scale is either oblong or broadly pyriform, its colour varies from reddish-brown to dusky brown, with the so-called exuvium at the apex, paler in colour; there is a distinct pure white lower scale. The latter remains on the plant when the insect is removed; the female is orange-yellow and the scale reaches about $\frac{1}{12}$ inch in diameter. The male is unknown.

It occurs on many other plants, such as the camellia, euphorbia, begonias, myrtles, asparagus fern, but only under glass in this country.

It increases with great rapidity, there being a succession of broods, reproduction always being parthenogenetic.

THE NARROW FIG SCALE.

(*Lepidosaphes fici*. Signoret.)

This Coccid is sometimes found on figs under glass. Morgan (1) refers to it as having been found in abundance on pot figs at the Royal Horticultural Society's Gardens at Chiswick. The plants had been imported from France fifteen years previously.

The scale much resembles that of our Apple Mussel Scale, but that of the female is more elongate, but narrower,



FIG. 184.—CAMELLIA SCALE
(*Aspidiotus camelliae*).

1, female scale ($\times 25$); 2, scales on young figs.

and less dilated at the posterior extremity. It is about $\frac{1}{2}$ inch in length.

THE LONG BLACK SCALE.

(*Ischnaspis filiformis*. Douglas.)

This very marked scale insect now and again may be found on figs under glass. It can at once be told by its length and narrowness, many of the female scales are nearly $\frac{1}{8}$ inch long. In colour the scale is shiny black with grey edges, an orange spot at one end (the larval exuvium); as a rule they are about eight times as long as broad; beneath the scale is white, a nearly complete ventral scale being present. The adult female in the scale chamber is elongate and yellow. The male scale is small and much shorter than the female. The male insect is unknown. Its scale is only $\frac{1}{25}$ inch long.

This Coccid I have found twice on figs, and Newstead (2) records it on ficus in Ireland. Many plants are subject to its attack, including palms, *Anthurium*, *Strychnos*, *Myristica*, *Latania*, *Magnolia*, *Jasminum*, *Monstera*, and on coffee at Lagos.

It occurs in the open in Brazil, Japan, Demerara, West Indies and Panama. It is said to be particularly difficult to destroy, and thus should be stringently guarded against.

TREATMENT OF FIG SCALES.

The Soft Brown Scales and the others mentioned may do a lot of harm if allowed to spread. It is important to clear them off the wood at once, and so stop them from getting on to the foliage and fruit.

The best treatment is hand-sponging with dilute emulsion when the leaves are off, followed later by a good syringing with plain water; and when the Soft Brown Scale is the culprit the addition of quassia, as it cleans off the smut fungus, etc., which follow after the insect.

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- (2) *Newstead, R. 'Mono. British Coccidæ'* I., p. 212 (1900).

GOOSEBERRY.

LIST OF INSECTS, ETC., INJURIOUS TO THE
GOOSEBERRY.

A. LEPIDOPTERA.

- CURRENT CLEARWING (*Egeria tipuliformis*. Clerck.). Stems and Shoots, p. 203.
 MAGPIE MOTH (*Abraixas grossulariata*. Linn.). Foliage, p. 206.
 DOT MOTH (*Mamestra persicariæ*. Linn.). Foliage, p. 264.
 WINTER MOTH (*Cheimatobia brumata*. Linn.). Foliage, p. 50.

B. COLEOPTERA.

- RED-LEGGED WEEVIL (*Otiorhynchus picipes*. Linn.). Buds and Foliage, p. 426.

C. HYMENOPTERA.

- CURRENT AND GOOSEBERRY SAWFLY (*Nematus ribesii*. Cam.). Foliage and Fruit, p. 266.
 THE ALLIED SAWFLY (*Nematus consobrinus*. Voll.). Foliage and Fruit, p. 272.
 THE BLACK-BODIED SAWFLY (*Nematus appendiculatus*. Htg.). Foliage, p. 274.
 GOOSEBERRY EMPHYTUS (*Emphytus grossulariae*. Kl.), p. 275.

D. HEMIPTERA.

- GOOSEBERRY APHIS (*Aphis grossulariata*). Foliage and Shoots.
 CURRENT APHIS (*Myzus ribis*. Linn.). Foliage, p. 219
 BROWN SCALE (*Lecanium persicæ* var. *sarothamni*). Shoots and Wood, p. 226.

E. ACARINA.

- GOOSEBERRY RED SPIDER (*Bryobia nobilis*. Th.). Foliage, p. 278.

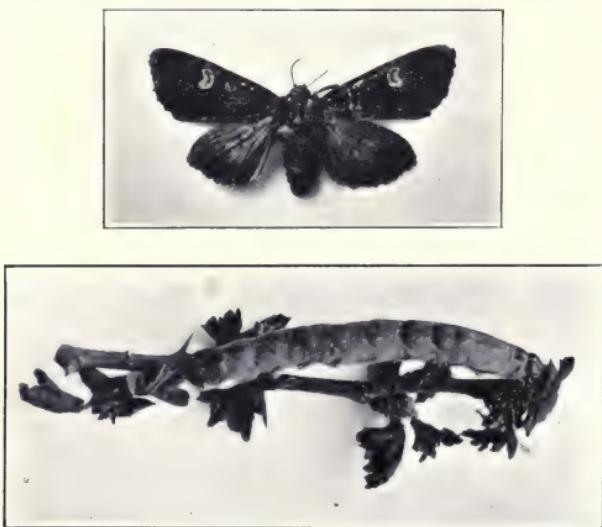
F. MOLLUSCA.

- GREY SLUG (*Agriolimax agrestis*. Linn.). Blossoms, p. 282.

THE DOT MOTH.

(*Mamestra persicariae*. Linn.)

The Dot Moth caterpillars are very frequently recorded as pests on the gooseberry. Their food plants are varied; as a rule garden flowers suffer most, such as dahlias, marguerites, marigolds, pansies, geums, etc.; vegetables are also eaten by these larvae, including cabbages of all kinds, lettuce, mint, parsley; fruit trees and bushes are also attacked; there are numerous accounts of their feeding on the gooseberry and now and again on apple, plum, raspberry, currant.



(F. Edenden,

FIG. 185.—MOTH AND CATERPILLAR OF THE DOT MOTH (*Mamestra persicariae*).

Other plants upon which it feeds are lilac, poplar, clematis, ivy, etc. (1).

They are ravenous feeders, stripping the plants in a very short time.

This insect is found all over Great Britain and in most parts of Continental Europe.

The caterpillars are subject to great variation in colour, apparently influenced to some extent by their food; the colouring rendering them often extremely difficult to find when at rest upon their food plant.

LIFE-HISTORY AND HABITS.

The moth appears in June and July. In size it varies from $1\frac{1}{2}$ to $1\frac{3}{4}$ inch; the front wings are blackish (with a dull purplish gloss when fresh) marked with rusty brown marks, with small pale spots at the tips and the hindermost edge, often, however, indistinct and with a large white kidney-shaped dot, often very pronounced; the hind wings are dusky-grey shading into dull whitish at the base. They fly at night and deposit their eggs upon the food plants; as many as thirty are laid by each female. The larvæ appear from the beginning of July until the latter part of August, the last hatched ones not maturing until the end of September, and some even being found as late as the middle of October; the majority have reached maturity by the end of September.

The larva varies in colour from pale green to grey or deep green and even reddish-grey; there is a pale dorsal line and semi-lozenge-shaped darker marks along the back from the fourth to the eleventh segments; the spiracular line is somewhat paler and there are five dark oblique bands below, the twelfth segment is distinctly humped; the first two pairs of the dorsal markings are always deepest in hue; the head is green, and the thoracic shield has two dark green to brown patches. That they vary in colour, according not only to the plant upon which they live, but also upon the same plant according to the part of the plant attacked, is well known. Buckler (2) figures four larvæ from *Pteris aquilina*; the green ones occurred on the green parts of the leaves, the brown on the brown parts.

When mature the larva reaches about $1\frac{1}{2}$ inch in length, it then falls to the ground and changes into a brown pupa in the earth beneath where it has been feeding and remains in that condition until the following summer.

PREVENTION AND REMEDIES.

In gardens hand-picking is advisable: it is a sure means of lessening attack. Where they occur in large numbers on gooseberry and fruit bushes it would be best to spray with some arsenical wash. It is said that if they are shaken off the plants, and then the ground drenched with cold water, especially if the weather is hot, that violent purging is brought on, and the caterpillars are reduced to mere skins (3).

Gardens that have been attacked by the Dot Moth larvæ should be lightly forked over, so as to expose the pupæ and so place them where they can be devoured by birds. It would be worth while to

let ducks run over the infested ground, or if an orchard, fowls ; both ducks and fowls devour the pupæ readily.

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- (3) *Ormerod, E.* 'Handbook of Insects Injurious to Orchard and Bush Fruits,' p. 86 (1898).

THE COMMON GOOSEBERRY AND CurrANT SAWFLY.

(*Nematus ribesii*. Scop.)

Both currant and gooseberry are attacked by the larvæ of this sawfly, especially the gooseberry. The red currant is frequently



[F. Edenden.

FIG. 186.—RED CurrANT BUSH DEFOLIATED BY SAWFLY LARVÆ
(*Nematus ribesii*).

attacked, the black currant but rarely. The larvae not only strip the leaves, but the fruit of the gooseberry is also devoured by them.

The attack of this pest cannot well be confused with any other, save that of the allied species of *Nematus*, *N. consobrinus* and *N. appendiculatus*. Sawfly larvae are easily distinguished by the number of prolegs, in this genus fourteen, which, together with the six true legs, makes twenty legs in all.

This insect occurs over most of Britain. Whitehead records it from Cambridgeshire, Gloucestershire, Kent and Worcestershire (1),



[J. G. Blakey.

FIG. 187.—OVA OF GOOSEBERRY SAWFLY. ($\times 2$).
(Not in normal position.)

especially in the years 1876, 1879 and 1881; Ormerod (2) from various places in Scotland, also Herefordshire, Buckinghamshire, etc. Carpenter records it (3) from Ireland. Reports or observations made in Devon, Somerset, Huntingdonshire, Surrey, Middlesex, also Sussex and Yorkshire, show it to be common in those counties. Probably it occurs wherever the gooseberry and currant grow.

LIFE-HISTORY AND HABITS.

The adult is rather variable in colour and size, and differs considerably in the two sexes.

The female is yellowish to almost orange, with black head, three

large black marks on the mesothorax, and most of the pleuræ also black; antennæ are deep brown to black, sometimes testaceous beneath; legs pale testaceous yellow, coxæ and trochanters very pale, apex of the posterior tibiæ and all the hind tarsi deep brown, also the tarsi of the fore legs to some extent. Wings transparent and iridescent, the stigma black, the costa testaceous at the base. Length $\frac{1}{3}$ inch.

The male has the thorax nearly all black, except a yellow band in front, and the dorsum of the abdomen is black except at the



[F. Edenden.]

FIG. 187A.—THE GOOSEBERRY SAWFLY.
A, stripped shoot; B, immature larvae feeding on leaves.

apex, the sides and lower surface yellowish. The last abdominal segment is expanded into a projecting lobe in the middle. Length $\frac{1}{4}$ inch.

This species can at once be told by the back of the thorax, the scutellum and metanotum being always yellowish. The adults appear in April and May, and occur in three successive broods at least during the summer. The female deposits her eggs in rows along the ribs of the leaves, on the underside. As many as forty eggs have been counted on one leaf. The ova are deposited separately, each egg being placed in a small slit cut in the leaf by means of the saw-like processes characteristic of the females of these insects. Unlike some of the Tenthredinidæ, the eggs are only slightly buried

in the leaf substance. I have failed to detect any gummy covering deposited by the female said to be present over them. In colour they are almost white to a pale translucent green. The length of the egg stage is from five to twelve days, according to climatic conditions (4).

The larvae are green when young, with black heads and small black specks on the body. The first and part of the second segment and the last two segments are orange-yellow. Over each leg is a black spot, elevated, forming a kind of tubercle; over each proleg are a pair of black spots, and on the upper part of the segments are numerous black points; on the first are eight black spots, on the second and third six on each side; on each abdominal segment are twelve spots, exclusive of the pair on the legs; the spots on the dorsum are roughly arranged in two parallel rows of six each, while those below are irregularly placed. On the upper surface of the anal segment is a large black patch, and on each side where the patch narrows are six or seven small black spots. After the last moult the larvae

assume a different appearance, they become pale apple-green to bluish-green, orange behind the head and on the tail, whilst the head is pale brown or dull green instead of being black—no spots occur at all. Now and then pale yellow forms occur in this stage. When full grown they reach nearly $\frac{3}{4}$ inch in length.

When first hatched the larvae feed off the epidermis of the leaf; after a day or so they commence to devour little round holes right through the surface, the larvae holding on to the edge of the hole. When they get about half-grown they disperse over the bushes and



(J. G. Blakey.)

FIG. 187B.—MATURE LARVÆ. ($\times 2.$)

feed very ravenously ; fifty having been observed to strip a moderate-sized gooseberry bush in three days.

The earliest date that the larvae were observed in 1901 to reach their full-fed stage was the 3rd of June, when many under observation commenced to pupate. At the same time there were on the bushes quite small larvae, not one-third grown. These were also of the first brood, but from eggs laid later than the fully mature ones. It appears that the same generation of pupæ may hatch out over a period of four weeks.

The larvae when ready, fall to the ground and then bury themselves just under the earth, where they spin a brown or dull yellow case of parchment-like silk, mixed with saliva. This cocoon becomes covered on the outside with little grains of earth. The variety of the colour of the cocoon is very marked, some are very deep coffee-brown, others pale brown and yet others almost yellow. All the larvae do not enter the soil to pupate, for it is by no means unusual to find the cocoons spun against and under a leaf or twig lying on the ground. The majority, however, pupate in the soil in earth-covered cocoons. The pupa is yellowish-green, often very pale, with orange on the thorax and on the apex of the abdomen. The pupal stage lasts during the summer from ten days to nearly three weeks. Miss Ormerod (2) says three weeks.

The winter is always passed in the larval stage inside the cocoon beneath the earth, the larvae pupating in the early spring.

NUMBER OF BROODS OF *N. RIBESII*.

Cameron (5) says two broods exist. This statement seems to have been repeatedly copied. From observations made during the last twenty years I find that there are nearly always more than two broods ; and as many as four have been observed. During the year 1903 three broods had appeared by July. The first brood appears from April to the end of May ; hence we find larvae of all sizes on the bushes during the late spring. The first hatched larvae pupate from the middle to the end of May, these hatch out in May and early in June. The larvae of the second brood have been observed to mature by the 20th of June, and from these a third brood have been hatched in July. In 1887 I obtained a fourth generation from these flies, which grew rapidly and went to earth on the 2nd of August.



FIG. 188.

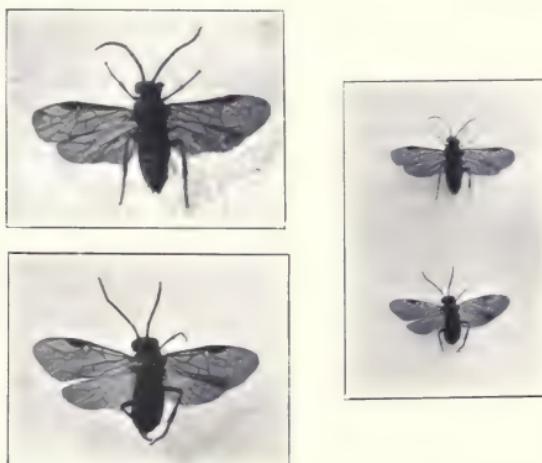
COCOON OF GOOSEBERRY
SAWFLY.

This fourth brood is unusual, but three frequently occur. Although these generations are quite distinct they generally overlap one another. The number of generations appears to depend on the weather. When it turns cold and wet, not only is development arrested but the larvae are actually destroyed; in warm fine weather they, on the other hand, develop rapidly.

NATURAL ENEMIES.

There are quite a number of parasites recorded on this insect, but on no occasion have I been fortunate in observing any one of them.

Cameron (5) records the following parasites: *Clipes nitidula*, F.; *Omulus armalus*, Dbn.; *Limneria argentata*, Gr.; *Mesoleius melan-*



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FIG. 189.—MALE AND FEMALE GOOSEBERRY SAWFLIES.
(Natural size and magnified.)

leucus, Gr.; *M. armillatorius*, Gr.; *Mesochorus confusus*, Hmgr.; *M. grossulariae*, Rtz.; *Tryphon aubignus*, Gr.; *T. bipunctatus*, Gr.; *T. cephalotes*, Gr.; *T. compressus*, Rtz.; *Cteniscus frigidus*; *Perilissus limitaris*, Gr.; *Polysphincta ribesii*, Rtz.; *Pygostolus stricticrus*, Fab.; and *Degeeria flavicans*, Gour., in Europe.

Dr. Asa Fitch (6) has bred in America a Chalcid fly, the *Trichogramma pretiosa* of Riley, from the eggs of this Nematus, as well as from the ova of *Aleyrodes* and from those of a Noctuid moth.

The parasitised eggs of the sawfly become brown and abnormal in shape. The female Chalcid takes two and a half minutes to lay

her egg in that of the sawfly. Another parasitic Ichneumon attacking this pest in America is *Hemiteles nemativorus*, Walsh, parasitic on the larvæ.

The larvæ are also attacked by one of the "land bugs" (*Podisus placidus*, Uhler), which sucks out the body juices of the pests by means of its piercing proboscis. This hemipteron has black head, legs, thorax, and a red abdomen with a long black central spot crossed by a white line.

The larvæ of Lace Wing Flies (*Hemerobiidae*) also devour them when young.

No natural enemies are known to do much good in this country.

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- (2) *Ormerod, E. A.* 'Handbook of Insects Injurious to Orchard and Bush Fruits,' p. 101 (1898).
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- (4) *Theobald, F. V.* Journal S. E. Agri. Coll., No. 11, pp. 34-38 (1902).
- (5) *Cameron, P.* 'British Phytophagous Hymenoptera,' vol. II., p. 170 (1884).
- (6) *Fitch, Asa.* Twelfth Annual Report of the Injurious Insects of New York (1867) and Transactions of the New York Agricultural Society, vol. XXVII., pp. 931-992 (1867-1868).

THE ALLIED GOOSEBERRY SAWFLY.

(*Nematus consobrinus*. Völl.)

This insect is by no means as common as the former, but occasionally it is sent with inquiries. It occurs in Holland, Prussia and Siberia, as well as in Britain.

It also appears to be known under the name *Nematus umbrinus*, Zaddach. The female is slightly smaller than *N. ribesii*, but the males are much the same size. The female differs in having more yellow on the head, the scutellum and metanotum black, and the abdomen dark basally and showing basal median, dark bands and patches to most of the segments, and in some, most of the dorsum is dark to the seventh segment. Eyes surrounded with brown. The thorax is black, minutely punctured, the pronotum being pale fulvous; the legs are pale fulvous; base of the coxae, apex of the posterior tibiae and tarsi black; base of the femora and tibiae pale. The wings are hyaline and iridescent, and the base of the costa is testaceous, the stigma dark testaceous.

The insect seems very variable in regards to the amount of black on the thorax and abdomen. Cameron (1) gives two distinct aberrations as follows:—(a) as in type, but the pleurae mostly pale fulvous, instead of shining black, and (b) as in type, but the scutellum black. A distinct variety exists in which the antennæ, clypeus, scutellum, and pleurae are black, and the eyes not surrounded with brown; the dorsum of the abdomen being black to the seventh segment.

It appears somewhat later than *N. ribesii*. Miss Ormerod (2) says from a month to six weeks later.

Three eggs only seem to be deposited on each leaf. The larvæ are so far only recorded as feeding on the gooseberry. They have a green head with little black specks and soft hairs; the body is green and shiny and with transverse rows of black tubercles; the second segment and to some extent the last and the sides over the legs yellow; the back has a bluish tint, especially down the middle line.

When young the larvæ have a black head, green body with black specks. At the last moult they become entirely green with no specks, but with yellow behind the head and on the anal segments.

It will thus be seen that in the first and final stages the larvæ of the Allied Sawfly resemble those of the Common Gooseberry Sawfly. But the presence of yellow on the sides over the legs will at once distinguish it during the greater part of its development.

As far as is at present known only one brood occurs. The larvæ pupate in the soil, much as do those of *N. ribesii*.

Ormerod (2), however, records the following fact: "In observations sent me from Longleat, Mr. Taylor mentions that, unless the locality was just under the surface of the soil close to a wall or other dry place, he considered that the caterpillar preferred nail holes in the wall, or holes in wood for pupating." This is quite contrary to what we observe in most other *Nemati*, and is therefore of much interest.

Further observations are required concerning this species before anything definite can be said regarding its life-history.

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THE BLACK-BODIED SAWFLY.(*Nematus appendiculatus*. Htg.)

During 1897 a number of larvæ were forwarded from Surrey that were causing serious harm to some gooseberry bushes, that differed totally from the two former species. These proved to be those of the *Nematus appendiculatus*, a widely distributed sawfly, but seldom appearing in large numbers. Cameron (1) records it from Braemar, Clydesdale, Sutherland, Manchester district, York, Gloucester, around London, Glanvilles Wootton, and Devonshire. I have observed it frequently in Surrey, and have had it sent from Worcestershire, Cambridgeshire, Sussex and Kent (2).

On the Continent it has been observed in Norway and Sweden, Germany, Holland, France, and at Riga (Russia). It cannot be confused, either in the adult or larval stage, with either *ribesii* or *consobrinus*. The female is black, smooth and shiny; the abdomen is broad and stout; the legs are white with a yellowish tinge; coxae black at the base; femora reddish, dusky in the middle, the apex of the posterior tibiae and apical tarsal segments black. The transparent wings are iridescent, the costa and stigma testaceous.

In the male the hind femora are nearly all black, and the posterior tarsi are fuscous. In length the female is about $\frac{1}{3}$ inch, the male $\frac{1}{2}$ inch. Like *N. consobrinus* it is subject to slight variation, some specimens not being so pubescent as others. The females appear in May. Two were noticed laying their eggs on the 10th of May.

In colour the larva is green to greyish-green, the eyes being surrounded by black circles; from each of these patches proceeds a brown line, narrowing gradually and passing to the summit of the head where they join; the long slender body is much wrinkled; the second and eleventh segments are of a yellowish tint, and also the edges of the spiracles, the middle and posterior legs and the top of the anal segment; the legs are green with brown claws.

When full grown (the only stage in which I have seen them), they reach $\frac{1}{2}$ inch in length. Cameron (1) says the larvæ appear in June. Those sent me were nearly mature when received on the 14th of June, and pupated on the 20th of June. The partially grown and fully grown larvæ feed on the edges of the leaves, with the end of the body often curved in the typical *Nematus* fashion. The specimens under observation pupated in the soil, and formed first a silken then an earthy cocoon, just as the two commoner species

do. The first fly hatched on the 25th of July. Whether this constituted a second brood or a third brood I cannot say. Cameron says there are two generations during the year.

The larvae feed on the red currant as well as on the gooseberry, and I have one note of its occurrence on the white currant.

It appears to be known also under the two following names: *Nematus catharticus*, Foer, and *N. peleteri*, André.

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- (1) Cameron, P. 'Monograph of British Phytophagous Hymenoptera,' vol. II., p. 66 (1884).
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THE GOOSEBERRY EMPHYTUS.

(*Emphytus grossulariae*. Kl.)

This species of sawfly feeds on the gooseberry in England, but is too uncommon to do any harm.

PARTHENOGENESIS IN GOOSEBERRY SAWFLIES.

Parthenogenesis frequently occurs amongst the sawflies. It has been observed in *N. ribesii*, *N. consobrinus* and others by numerous observers.

Siebold (Beitr. zur Parth. d. Arth., pp. 107) and Kersler (Die Lebensgeschichte von *Ceutorhynchus sulcicollis* and *Nematus ventricosus*. Cassel, 1866) have both observed it.

"There is not the slightest doubt," says Cameron, "that *Nematus ribesii* possesses the faculty of laying unfertilised eggs which invariably yield only males."

This phenomenon was noticed as long ago as 1820 by Robert Thorn (Memoirs Caledonian Hort. Society, IV., pl. 2), but he imagined that male and female larvae copulated.

The eggs may be laid immediately after the females leave the cocoons and when these unfertilised females have been examined after oviposition no traces of spermatozoa were discovered in the ovaries, while they are easily seen in those that have been fertilised. The first statement made by Cameron was subsequently modified, for in the Appendix to Vol. I. of his Monograph (p. 218) he says that the virgin females of *Abia fasciata* and *N. ribesii* yielded males and females. In *N. rufa*, etc., males and females were also produced, but in *Hemicroa rufa*, *Eriocampa ovata*, *Nematus appendiculatus* and others without exception females only were bred.

Not only can this parthenogenesis last for one generation, but in one species at least (*A. fasciata*) Dr. Osborne (Ent. Mo. Mag., XIX. 97; XX. 200; XXI. 128) has shown that a third generation may be obtained without any male connection.

PREVENTION AND TREATMENT.

The attack of the gooseberry and currant sawfly is usually fairly persistent. Year after year certain gardens, and even certain parts of a garden, are attacked by these pests. This is when no steps are taken to check the increase of the insects, which, in all cases, pupate in the earth beneath the bushes. From these pupæ the adults emerge close to the food plant of their future progeny, and thus can readily deposit their eggs. It is therefore very desirable to check this increase, or to try and exterminate the pests when in their winter quarters.

This can be done by removal of the earth and pupæ. Removal of surface soil during the winter and burning it or burying it deeply whilst the fresh soil taken from the hole is placed beneath the bushes, is an excellent plan, and may well be practised when the number of bushes devastated has been small. The earth may also be burnt and soon replaced—all the cocoons thus being destroyed. The earth should be removed to a depth of 3 or 4 inches, as the winter is passed by the pupæ deeper in the earth than occurs during the summer. Where this plan has been employed it has met with success. In regard to the application of caustic substances to the soil, nothing answers better than gas lime, but it is very doubtful if it has much direct effect. Kainit has been employed with very doubtful results.

Turning the soil over does little good, for the cocoons have to be very deeply buried to prevent the adults from forcing their way out of the earth.

Benefit has resulted from the application of quicklime spread beneath the bushes and deeply dug in the autumn. A plan adopted by certain gardeners is to beat the earth under the bushes that have been attacked early in the spring, so as to make the soil too firm for the insects to pass through when they have hatched. Experiments made have not shown this plan to be of much use, for I found that even when the earth has been beaten much firmer than could be done under ordinary circumstances, the flies managed to force their way out.

It is too early yet to speak with confidence of the effect of

bisulphide of carbon injected into the soil in autumn, but from the results I have obtained it seems that it is effectual in clearing this pest out.

When the larvae are noticed on the bushes they may be got rid of in two ways. First, by *hand-picking*, and, secondly, by *spraying*.

A great deal of loss may be saved if the small colonies of *N. ribesii* are picked off early in the year. This should be done when we see the leaves every here and there looking as if riddled with fine shot; at this time all the larvae are collected together and can then be easily taken and destroyed, either by being squashed up in the hand or by being placed in a pail of quicklime. Later, when they spread out over the bushes, hand-picking entails considerable trouble. When the larvae of *N. ribesii* have once spread out, or when the more erratic larvae of *N. consobrinus* and other species occur, washing or spraying, to poison the larvae, is the most advantageous treatment. Two poisons may be used for the sawfly grubs, (1) hellebore and (2) arsenates. The only objection to either is that they are poisons. But no cases of poisoning have ever occurred, and both have been frequently used, not only in America but also in this country.

They must not be used on fruit that is ripening, or on green gooseberries that are going to be picked, for four weeks previous to gathering. *Hellebore* may be used either as a powder or as a spray; the latter is the best means of applying it. It should be mixed at the rate of one ounce of powdered hellebore to two gallons of soft water, a small quantity of soft soap being added. The hellebore powder must be quite fresh, as it soon loses its potent factors. The wash should be kept well mixed and applied in a moderately fine spray. By far the best way of coping with this pest is spraying with arsenate of lead, especially Swift's Paste, which clings to the foliage a long time.

Strong lime-water has also been used and found serviceable, put on in as fine a spray as possible, but it has to be applied more than once to have much effect. Mr. Bear of Magham Down, Hailsham, writes that he can kill the larvae with soft soap and quassia.

Later results by Pickering have shown that we may use weak paraffin emulsions to kill the larvae, and in the case of late attacks this is advisable.

THE GOOSEBERRY RED SPIDER.

(*Bryobia nobilis*, Th., or *B. ribis*, Thomas.)

Throughout all the chief gooseberry centres the Red Spider is quite the worst pest that growers have to contend with. It is abundant some years much more than others, but the exact factors

| *F. Edendea.*

FIG. 190.—NORMAL GOOSEBERRY SHOOT (ON RIGHT) AND SHOOT ATTACKED BY RED SPIDER (ON THE LEFT).

which govern the rapid increase of this acarus are not known. It is generally said that heat and drought are responsible, but when one goes over a number of statistics and meteorological records this does not appear to be the case. The mites certainly feed more and are more noticeable in warm sunny dry weather, and the bushes are not so hardy, but there does not seem to be any excessive reproduction from those causes.

Some of the worst attacks I remember have been after warm damp weather. The Red Spider is, of course, not an insect, it belongs to the eight-legged group of "jointed limbed animals," and to that section called *Acarina*.

The young of these Red Spiders are very like the adult, but have only six legs, as we find in the insects. They are oviparous, and the eggs (Fig. 192) are small globular bodies, very similar to those of the Hop Red Spider (*Tetranychus malva*); but on their smooth shell are a few white fibres.

The damage done by the mites is by their constantly sucking the sap from the leaves. The appearance produced is very marked, the larger leaves become marbled grey, sometimes almost silvery; the young leaves are stunted in bad attacks and present the appearance shown in the photograph reproduced here. The result is that the leaves and blossoms and even young fruitlets fall off.

This pest is well known in Cambridgeshire, Worcestershire, Devon, Cornwall, Gloucestershire, Kent, Surrey, Sussex, Middlesex, and extends up into Scotland. We may say practically wherever gooseberries are grown the Red Spider is found.

It has been described in various ways, some calling it *Tetranychus telarius*, one of the web spinning mites, others stating it is the same as the Red Spider on ivy, and calling it *Bryobia pretiosa* (2). Ormerod, quoting Harker, refers to this mite forming silken webbing "covering the whole of the ivy for quite one or two hundred yards," etc.

If this is the same species as she refers to on ivy in other places, it has nothing to do with the Red Spider of the gooseberry, for it does not form a web. Although Michael says (2) that it "swarms in millions on the ivy in gardens," we venture to doubt, under the circumstances, that they are the same acarus. The mite on ivy does not agree with the common gooseberry pest, which is apparently *Bryobia nobilis*, the same as the *Bryobia ribis*, Thomas.*

* A recent examination made of the ivy *Bryobia* (*B. pretiosa*) shows hairs of broad white structure in all stages of the mite. The Red Spider of gooseberries has only simple hairs in all its stages, so that the two can be easily separated.

LIFE-HISTORY AND HABITS.

This acarus belongs to the genus *Bryobia*, which is easily told from the Red Spider of plums, hops, etc., *Tetranychus*, by the first pair of legs being much longer than the rest, and all the legs longer than in *Tetranychus*.

In colour this mite is very variable : some are grey, others greenish, others rusty red ; some have red and brown coloration, yet others leaden grey or bright red ; the legs are pale or dull reddish. In size, large mature specimens may reach nearly $\frac{1}{30}$ inch.

They collect in dull weather in early spring in crevices on the wood or under the loosened skin upon it. So densely are they often packed together that they look like one red mass, their legs tucked under their bodies.



[F. E.]

FIG. 191.—THE IVY RED SPIDER (*Bryobia pretiosa*).
(Greatly enlarged.)

I have noticed that in this stage they are frequently of a rich red hue, almost crimson-lake. I have found them like this early in February, both in Kent and Cambridgeshire, in a semi-dormant condition. As soon as the young leaves show they are ready to move, the first warm sunny day they get on to the leaves and commence to feed and gradually mature. At night they return to their shelter, and also on dull damp days. They feed mainly on the undersides of the leaves, and the attack usually seems to start in the centre of the bushes and spreads outwards.

In April or even March they may have started to reproduce, when minute round globular shiny reddish eggs are laid on the twigs, base of the thorns, and on and between the old bud scales. These eggs, which can only be seen with a magnifying glass unless laid in large masses, hatch in four or five days into small semi-transparent young with six legs, these soon commence to feed, in another four days moult and become like the adult ; two more moults appear to take place, and then at the end of twelve to fourteen days they are ready to reproduce again.

What happens between June and the following February is not definitely known, but one may find the ova and immature mites on the wood at Christmas, and it is probable that most of the eggs laid in June remain until the winter, and that a few only hatch out before February and March and hibernate on the bushes. What regulates

their increase, their equally sudden disappearance, even in warm weather, are subjects about which much further investigation is necessary.

PREVENTION AND TREATMENT.

The recognised treatment for the Red Spiders has been some form of sulphur wash. Liver of sulphur has proved the most convenient form. It has, however, been found of no avail in certain years. For instance, in 1907, little good was done by spraying with this acaricide. The other acaricide found to work when sulphur fails is paraffin emulsion, and the best results have been obtained with paraffin jelly. Considerable success has also attended the use of nicotine washes, which I found by far the most successful of all in 1907.

The question of preventing the attack is one which growers naturally are most concerned with.

We know that the immature acari shelter in the crevices, etc., of the wood in February and March, and at this time a heavy spraying

would be sure to kill very many. Mr. John Riley of Putley Court, Ledbury, wrote me in 1902 that he had found great benefit from spraying with caustic alkali wash, and it is quite possible that this treatment in late winter kills the young acari.

Washing, in any case, in late February cannot fail to kill large numbers, and then fairly strong paraffin emulsion may be used; up to as much as five gallons of paraffin to 100 gallons of wash has been found to do no harm.

Where attack only makes itself noticeable in April or May then we must spray with either the liver of sulphur or the paraffin jelly, and it may be pointed out that to be of



FIG. 193.—EMPTY EGG-SHELLS OF RED SPIDER.
(Greatly enlarged.)



FIG. 192.—GOOSEBERRY RED SPIDER
AND OVA.
(Greatly enlarged.)

full value the bushes should be sprayed twice at an interval of about ten days, so as to kill any young which may have escaped from the later eggs.

The paraffin jelly mentioned may be made as follows:—

Paraffin, 5 gallons; soft soap, 8 lbs.; boil together, and when boiling add about one pint of water, and then well stir.

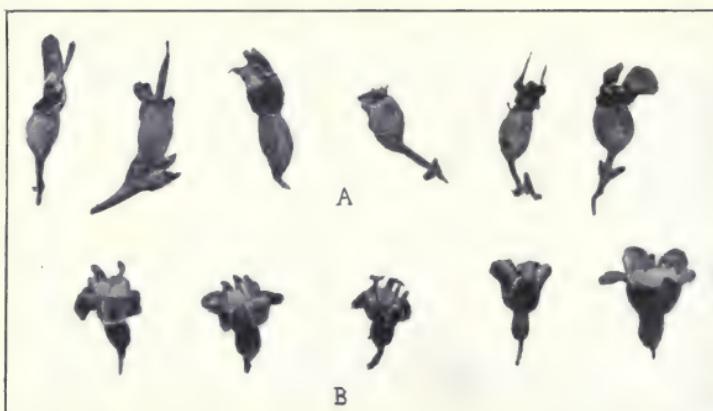
This becomes a jelly when cold, and 10 to 11 lbs. of which are added to 40 gallons of water.

The above amounts make about 160 gallons of wash.

This formula, used by Mr. Ballard of Pinvin, will be found quite one of the best for this purpose, and also kills the Brown Scale at the same time.

SLUGS (*Agriolimax agrestis*, Linn.) DAMAGING GOOSE-BERRIES.

Some three or four years ago, Mr. John Riley wrote regarding the damage to young gooseberries by slugs, but as he was unable to have any caught, the exact cause remained in doubt until 1906.



[F. Edouard.

FIG. 194.—A, GOOSEBERRY BLOSSOMS EATEN BY SLUGS; B, NORMAL BLOSSOMS.

Slugs have since been found to eat the base of the calyx, and then go on to another gooseberry; the gooseberries thus attacked die and fall off (Fig. 194).

Mr. Riley's manager, visiting Evesham, found that in one garden the whole of the crop was destroyed, scarcely a gooseberry being unbitten. This attack in that neighbourhood had been put down to frost. Mr. Riley says: "We had a very bad attack on two or three

acres close to where it was first, and they were heavily washed with Little's fluid sheep-dip ; they do not appear to have suffered from it ; it was used strong (one to seventy)." Later information sent showed that this damage was undoubtedly due to slugs, Mr. Riley stating that "careful examination at night revealed the fact that slugs were the culprits. We have caught them red-handed. In order to make climbing easy for them, we cut off branches of the gooseberries, and stuck them in the ground at night. Several slugs were soon seen eating the calyces, as described, and they were found in quantity under most bushes at night. Had we no foxes, I should try 500 ducks to clear them off."

A similar attack was reported in 1907 from near Canterbury, and slugs were caught eating the calyces at night at Wye in the same year.

There is no doubt that the employment of ducks is one of the best ways of ridding a plantation of such pests. It would be quite possible, even with foxes present, to use them during wet weather in daytime, when the slugs would be on the move.

This has been done in cases of slug attack in hop gardens with good results.

There does not seem to have been any previous notice of these mollusca doing harm in this way.

The attacked blossoms sent showed very characteristic signs of damage ; the eating away of the base of the calyx causes shrivelling, which might be mistaken for frost-bite if not examined, but the work of the slug can easily be detected if looked for.

The calyx itself in many cases, as seen in the figure, is eaten and turns brown. Sparrows have been accused of doing this, but their work can at once be detected by the debris of calyces found on the ground beneath the bushes.

I have found vaporite very successful in destroying slugs.

LOGANBERRY.

LIST OF INSECTS INJURIOUS TO THE LOGANBERRY.

A. COLEOPTERA.

RASPBERRY BEETLE (*Byturus tomentosus*. Fab.). Fruit and Blossom-buds, p. 420.

CLAY COLOURED WEEVIL (*Otiorhynchus picipes*. Fab.). Foliage and Shoots, p. 425.

B. DIPTERA.

DADDY LONG LEGS (*Tipula oleracea*. Linn.). Roots and tips.

C. LEPIDOPTERA.

HEART AND DART MOTH (*Agrotis exclamacionis*. Linn.). Roots, p. 450.

Note.—The above are, so far, the only insects referred to me or recorded as attacking this valuable fruit. Probably all our Raspberry insects will invade it. The Raspberry Beetle is the most important, and does far more harm than it does on the Raspberry. The Clay Coloured Weevil has been found harmful in the Cheddar district, the Leather Jackets in Worcester, and the Heart and Dart Moth I found on the roots in Kent.

NUTS.

COB AND FILBERT, SPANISH CHESTNUT
AND WALNUT.

LIST OF INSECTS, ETC., INJURIOUS TO NUTS.

I.—To COB AND FILBERT.

A. LEPIDOPTERA.

- WINTER MOTH (*Cheimatobia brumata*. Linn.). Foliage, p. 50.
MOTTLED UMBER MOTH (*Hybernia defoliaria*. Clerck.). Foliage, p. 58.
BUFF-TIP MOTH (*Phalera bucephala*. Linn.). Foliage, p. 292.
NUT-LEAF BLISTER MOTH (*Lithocolletis coryli*. Nicelli). Foliage, p. 297.

B. COLEOPTERA.

- NUT WEEVIL (*Balaninus nucus*. Linn.). Fruit, p. 299.
LEAF WEEVILS (*Phyllobius sp.*). Foliage, p. 119.
NUT LEAF WEEVIL (*Strophosomus coryli*. Fab.). Foliage, p. 302.

C. HYMENOPTERA.

- NUT SAWFLY (*Cræsus septentrionalis*. Linn.). Foliage, p. 303.

D. DIPTERA.

- CATKIN MIDGE (*Cecidomyia coryli*. Kalt.). Male Catkins, p. 306.

E. HEMIPTERA.

- THE NUT APHIS (*Siphonophora avellanae*. Linn.). Foliage and Shoots.
THE CUCKOO SPIT INSECT (*Philænus spumarius*. Linn.). Shoots, p. 200.
LEAF HOPPER (*Chlorita viridula*. Fall.). Leafage, p. 392.

F. ACARL.

- THE NUT BUD MITE (*Eriophyes avellanae*. Nalepa). Buds, p. 307.

II.—To SPANISH CHESTNUT.

A. LEPIDOPTERA.

- GOLD TAIL MOTH (*Portesia similis*. Fues.). Foliage, p. 27.
SHINY CHIMNEY SWEEP (*Fumea intermedia*. Brd.). Foliage.
GREEN OAK TORTRIX (*Tortrix viridana*. Linn.). Foliage.
THE NUT FRUIT TORTRIX (*Carpocapsa splendidana*. Hb.). Fruit, p. 309.
BROWN OAK CASE-BEARER (*Coleophora lutipennella*. Zell.). Foliage.

B. COLEOPTERA.

- THE LEAF BOX BEETLE (*Attelabus cuculionides*. Linn.). Foliage, p. 311.

III.—TO WALNUT.

A. LEPIDOPTERA.

- WINTER MOTH (*Cheimatobia brumata*. Linn.). Foliage, p. 50.
 WOOD LEOPARD (*Zeuzera pyrina*. Linn.). Wood, p. 46.
 VAPOURER MOTH (*Orygia antiqua*. Linn.). Foliage, p. 38.
 THE NUT FRUIT TORTRIX (*Carpocapsa splendidana*. Hb.). Fruit, p. 309.
 CODLING MOTH (*Carpocapsa pomonella*. Linn.). Fruit, p. 69.

B. HEMIPTERA.

- THE DUSKY-VEINED WALNUT LOUSE (*Ptychodes juglandis*. Frisch).
 Foliage, p. 313.
 THE COMMON WALNUT LOUSE (*Pterocallis juglandicola*. Kalt.). Foliage, p. 316.

C. ACARI.

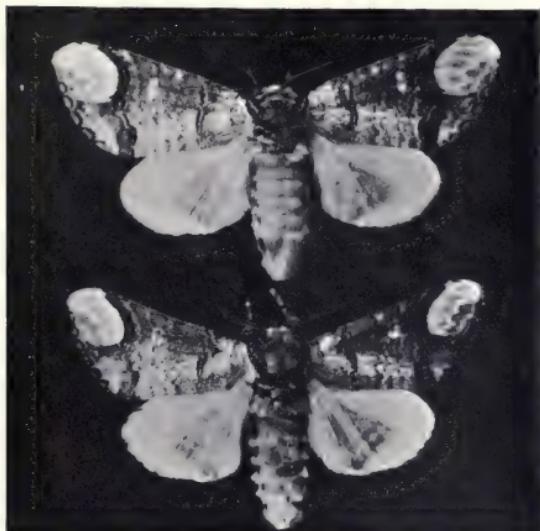
- THE WALNUT LEAF GALL MITE (*Eriophyes triseriatus v. erinea*. Nalepa).
 Foliage, p. 318.

I.—TO COB AND FILBERT.

THE BUFF-TIP MOTH.

(*Phalera bucephala*. Stephens.)

Inquiries have frequently been made during the autumn months concerning the larvæ of the Buff-tip Moth (*Phalera bucephala*). These caterpillars very frequently occasion a great deal of harm to the leafage of the elm, lime, beech, birch, nut, sallow, rose and oak. Fruit trees are also sometimes attacked. Frequent reports come to hand of their ravages on rose, elm and lime trees in and around London, and also in nut plantations in Kent. Mr. F. Smith of Loddington finds them in his nut plantations and Mr. Buley of Woodnesborough found them attacking cobs and filberts. In the same year I found them defoliating cobs at Wye and they were also reported from S. Devon and elsewhere. Recently they have been causing some alarm in cherry orchards (1). Mr. Lewis Levy wrote in 1906 from Borden Hall, Sittingbourne, in August, saying: "We have had several cherry trees whose leaves have been almost devoured by the caterpillars. Over one hundred, I should say, on one tree." The moth (Fig. 195) is common and very generally distributed over Great Britain and generally attracts attention on account of its peculiar and beautiful appearance, whilst the large size of the caterpillars, and the havoc they cause, render them particularly conspicuous objects. The eggs are also often sent with inquiries as to their nature.



[E. Tonge.]

FIG. 195.—MALE AND FEMALE BUFF-TIP MOTHS.
(Natural size.)



[E. Tonge.]

FIG. 196.—EGGS OF BUFF-TIP MOTH. ($\times 20$.)

LIFE-HISTORY.

The moth usually makes its appearance in June and continues until July, specimens having been sent as late as the 27th of July in



[F. Edenden.]

FIG. 197.—IMMATURE LARVAE OF BUFF-TIP ON HAZEL.

1886, and the 25th in 1888. These are two of the latest dates I have of its capture. The earliest is the 2nd of June. In Germany, according to Kollar (2), it occurs as early as May. The moth measures from

$2\frac{1}{2}$ inches to $2\frac{3}{4}$ inches across the expanded wings. The fore wings are ashy grey, silvery grey at the base and inner edge; there are two transverse streaks of dark brown and reddish-brown, one near the base and the other towards the apex of the wings, a pale spot towards the middle, and a large pale ochreous or buff spot at the tip of each wing; the hind wings are plain yellowish-white; the head is yellowish, densely scaled; the thorax with dense yellow scales, bounded behind with two rusty-brown lines, somewhat raised up into a tuft; the abdomen pale ochreous to buff; the female has simple, the male crenulated antennæ. Miss Ormerod (3) states that the eggs are usually laid on the upper surface of the leaves. I have never seen them so placed, but on the *under* surface or on the shoots.

They are rounded and very convex above, flat beneath, the upper part is pearly white, with a median dark spot, the lower part bright green, the latter forming a distinct green basal band; they are rather large objects, and are firmly glued to the leaf and darken somewhat before the larvæ escape, which usually takes place between ten and fourteen days after they have been laid. They are laid in groups of from twenty to seventy.



[F. Edenden.

FIG. 199.—LARVA OF BUFF-TIP MOTH.

numerous fine hairs are dotted over the whole body. The first moult takes place about ten days after the larvæ have hatched out. At



[A. V. D. Rintoul.

FIG. 198.—BUFF-TIP MOTHS AT REST AND OVA (A).

The larvæ (Figs. 197 and 199) are gregarious and reach 2 inches when mature. The ground colour is dark yellow, a broad black line runs down the dorsum, and on each side are three black lines which are interrupted by yellow or orange transverse rings on the segments; head dark brown; and

first the whole batch of larvae feed together, but later they separate into smaller groups of from ten to twenty. When young and feeding all together they skeletonise a leaf or two in very conspicuous manner, but when they are larger they disperse over the leaves. When at rest they lie close together, usually on the upper surface of the leaf, lying parallel with one another. They are mostly mature by the middle of September, but I have had them sent as late as October. When full fed they fall or crawl to the ground and pupate under the soil. The pupa (Fig. 200) is not encased in any cocoon or even cell of earth. It is deep brown, thick, about 1 inch in length,

smooth with two spines at the apex. Sometimes they lie under fallen leaves, but generally beneath the soil, where they remain all the winter and hatch out in May, June and July (4).



FIG. 200.—PUPA OF BUFF-TIP MOTH.

that care must be taken to destroy them all. If many are present it would be as well to tie bands of hay round the trunks of the trees near, especially around the infested one, and to smear the bands with tar so as to prevent the larvae ascending again, but when there is no herbage beneath the trees they can all easily be killed, so that banding is not necessary. Whenever the groups of young larvae are seen, the leaf should be picked off at once and destroyed, before they spread into smaller companies.

Spraying with any arsenical washes would poison the larvae, and for this purpose the arsenate of lead wash may be used on cherries and nuts.

REFERENCES.

- (1) *Theobald, F. V.* Report on Economic Zoology for the year ending April 1st, 1907, p. 44 (1907).
- (2) *Kollar, V.* 'A Treatise on Insects Injurious to Gardeners, Foresters and Farmers.' (Trans. J. and M. Loudon), p. 321 (1840).
- (3) *Ormerod, E. A.* 'Manual of Injurious Insects,' p. 227, 2nd ed. (1890).
- (4) *Theobald, F. V.* Report on Economic Zoology for the year ending April 1st, 1906, p. 45 (1906).

THE NUT-LEAF BLISTER MOTH.

(*Lithoccolletis coryli*. Nicelli.)

Nut leaves, both wild and cultivated, are often seen to be marked with large pale blisters, ranging up to nearly $\frac{1}{2}$ inch in width. These blisters are sometimes roundish, at others rather elongate. They are caused by a small leaf-mining moth caterpillar, known as *Lithoccolletis coryli*. These mines occur on the upper sides of the leaves. Another species, *Lithoccolletis nicellii*, occurs on the lower sides, but I am not sure if this species occurs in Britain.

During the late summer of 1906 the nut leaf miner seems to have been abnormally abundant, both in the hedgerows on hazel and amongst cultivated cobs and filberts in many parts of Britain.

The damage done to the leaves, especially in young plantations, must have been severe, checking the further growth and development of the shoots.

In this country it is common in Devonshire, Somersetshire, Gloucestershire, Surrey, Kent, Cheshire, and has occurred in various parts of Yorkshire (Stainton recording York, Scarborough, and Stockton-on-Tees), the last-named authority also gives the Cumberland Lake district, and Cockburnspath in Berwickshire.

In 1906 it was very abundant in parts of Kent, some cobs being seen with all the leaves blistered, many having six or seven blisters on them. Badly attacked trees were seen in Devonshire, but I only noticed it in one place in Worcestershire and one in Herefordshire.



[F. Edenden.]

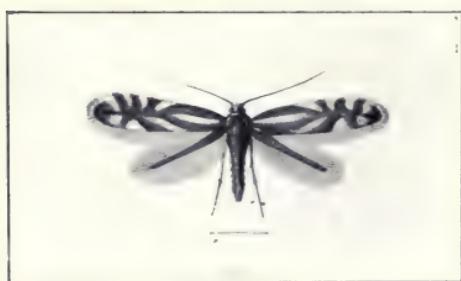
FIG. 201.—NUT LEAVES MINED BY THE NUT-LEAF BLISTER MOTH LARVÆ.

LIFE-HISTORY AND HABITS.

The moth appears in May; in 1906 as early as the 12th of May at Wye, the year before not until the 27th. In size it varies from 7 to 8 mm. in wing expansion. The anterior wings are pale ochreous brown, with a snowy white basal streak, and on the inner margin a thin white streak much smaller than the above; towards the apex four white converging areas above and three below; the hind wings are white with dusky base, and the long fringes are grey in the female, of a dull yellowish tinge in the male. The thorax is the same colour as the wings, with a median and lateral white stripes.

The abdomen is grey, and the tuft pale ochreous. The legs are grey, with white tarsal segments spotted with fuscous.

They lay their eggs on the leaf, choosing, it seems, a still, fine evening just before sunset. The larvae then burrow into the leaf, and feed upon the soft mesophyll and eat it out



(Horace Knight.)

FIG. 202.—NUT-LEAF BLISTER MOTH (*Lithocolletis coryli*).

in a more or less rounded area, the upper epidermis being left intact, but quite separate from the rest of the leaf and showing quite white (I have never seen the ochreous central area described by Stainton). Occasionally, when the mine is near a mid rib or the edge of the leaf, the leaf becomes much puckered and folded.

In this blister the larva may be found up to the beginning of July.

When mature the larva reaches about 4·5 mm. in length. It is pale yellowish-green, the first three segments more yellowish, and the eighth with a somewhat obscure orange-yellow spot; the last two segments are yellowish. The head pale brown, with dark brown markings; when retracted the lobes show through the first segment as two brown spots. Legs very pale.

This larva, when quite young, lies in a curved position, but as it reaches maturity it straightens out. It can generally be seen in the mine at work by holding the leaf up to a strong light. Some dusky spots are noticeable beneath in the young larva, but they soon disappear.

Pupation takes place in the blister, and by the first or second

week in August a second brood of moths appear. These soon pair, and lay their eggs as before. If circumstances are favourable, a great many eggs are laid, and the result, as we saw in 1906, is that the leaves become covered with blisters in September. This second brood of larvae reach maturity in early October. They then pupate as before, and the moths hatch out and hibernate. At least, this is what is apparent, for they have not been observed in any other condition during the winter.

I have failed to find any winter pupæ in the leaves, and yet all the larvae pupated there. Those kept hatched out, and none could be found in the leaves naturally.

Unless I am much mistaken this is the normal way of wintering, and thus we have another reason for separating this nut species from *Lithocolletis carpinicolella*, which is found in the pupal stage in the dead leaves of the hornbeam, which hang so readily on to the trees during winter. The adult of *L. carpinicolella* is, however, very like *L. coryli*.

TREATMENT.

This is very difficult, but I found a heavy spraying with arsenate of lead used for Nut Weevil kept the trees clear of the first brood, but that the second brood invaded the same trees from some old cobs and filberts standing close by.

A heavy spraying of arsenate of lead is undoubtedly good for nuts if used in May; at this time the Winter Moth, Nut Weevil, Leaf Weevils, and these Miners can all be attacked by it, and as it holds on to the leaf well, later comers, such as the Crœsus Sawfly and the Buff-tip Moth, are also to some extent destroyed.

THE NUT WEEVIL.

(*Balaninus nucus*. Linn.)

This weevil is the parent of the maggot so frequently seen in nuts. It is found in the filbert and cob and also in the wild hazel nuts. Kaltenbach (3) refers to it on the oak. The filbert seems to suffer from it more than the cob, but growers in Kent report it doing harm to the latter. The damage is done by the maggots feeding in the kernel and causing the nuts to fall prematurely, and also by spoiling the samples owing to the repulsive appearance of the maggot found on cracking the nuts.

It occurs fairly widely over Britain where the hazel is abundant,

but it is in Kent that it is most harmful to cultivated nuts, owing, of course, to that county being such a large producer.

It is common also in France, where it often does much harm to the noisettes (1). Taschenberg (2) refers to it in Germany, and also Kaltenbach (3).

LIFE-HISTORY AND HABITS.

This weevil can readily be told by its long curved snout; in length it is about $\frac{1}{3}$ inch; the colour is tawny-brown to chocolate-brown,



[A. V. D. Rintoul.]

FIG. 203.—THE NUT WEEVIL (*Balaninus nucus*) AND DAMAGED NUTS.

densely clothed with golden brown pubescence, which becomes greyish as the beetle gets old; the wing cases have rows of dots, the thorax and proboscis are chestnut to tawny-brown, and the elbowed antennæ are very similar in colour. Like other weevils, the biting mouth is situated at the tip of the proboscis.

The time of appearance, as far as personal observations go, is June, the dates varying during the last fifteen years between the 10th of June and the 25th of June. Ormerod says they "may be found as early as May." Whitehead mentions "about the beginning of July" (1), and again Ormerod says "it is stated that some of these beetles do not develop till July or August." I have been unable to find any fresh beetles in Kent as late as July, but the weevils live on well into that month. They can live for six or eight weeks in confinement, but such appears to be unusual.

Both males and females fly, especially in warm bright weather, and alight on the bushes with considerable force. They do not take wing when frightened, but fall to the ground. It is strange how difficult they are to see when on the bushes, and one is frequently surprised to find numbers falling down when the bushes are shaken.

The female bores a hole in the young nut with her rostrum, and then deposits a single egg in the hole. Sometimes this hole is made through the calyx and soft shell, at others the calyx is not pierced. The female is said to push the egg deep into the nut with her snout and then proceed to deposit another in a fresh nut.

The egg hatches in eight or ten days. The larva—the so-called nut maggot—feeds on the kernel, which it tunnels or grooves out on one side, and its moist “frass” may hasten decay, but not until the maggot is mature.

In form it is much like the larva of other weevils, but it is very soft, pale creamy white, fat and curved at the tail end, slightly hairy and has a quite hard brown head. In length it is rather more than $\frac{1}{3}$ inch. When mature it eats its way out of the nut, boring a small round hole in the hard shell. It is an interesting sight seeing the maggot escape, gradually squeezing itself through the hole which is so much smaller than its body. It finally falls to the ground, or, if the nut has fallen, escapes into the soil direct. It then forms a cell in the earth where it remains in the maggot stage all the winter, pupating in the early spring. The pupa is creamy white. From this the weevil escapes and feeds upon the leafage until the nuts are ready to receive the eggs.

It has been suggested that those weevils which are seen in July and even August, and which are thought not to have hatched until then, may possibly hibernate (4) and appear with those that emerge from the pupæ in June.

PREVENTION.

The beetle may be collected in numbers by jarring the bushes over tarred sacks or boards. There is no doubt that this plan can be followed with success.

Stirring the soil in winter is sure to damage many of the soft maggots and pupæ and expose others to the attack of birds. Observations have been made which show that good cultivation under the nuts is very necessary as a preventive measure.

Mr. Fred Smith of Loddington informs me that he finds that where he sprays his nuts with arsenate of lead for Winter Moth that

the Nut Weevils are killed at the same time. This I tried at home with complete success.

NATURAL ENEMIES.

Whitehead (1) refers to the good done by Tits, and describes the Great and Blue Tits hunting for the beetles. No definite observations have been made, and this statement must be taken with caution.

REFERENCES.

- (1) Whitehead, Sir C. 'Insects Injurious to Fruit Crops, p. 25 (1886).
- (2) Taschenberg, E. L. 'Insekten-kunde. Die Kafer und Hautflügler,' p. 147 (1879).
- (3) Kaltenbach, J. H. 'Die Pflanzenfeinde aus der Klasse-Insekten,' p. 633 and p. 647 (1874).
- (4) Ormerod, E. A. 'Handbook of Insects Injurious to Orchard and Bush Fruits,' p. 116 (1898).

THE NUT LEAF WEEVIL.

(*Strophosoma coryli*. Fabr.)

This insect is referred to by Ormerod (1), but I am not aware that it does any harm to nuts in this country. No growers I have consulted know anything of it, nor have I seen it on any cultivated nuts. Miss Ormerod's notes appear to have been mainly culled from Taschenberg (2), Kaltenbach (3) and Stephens (4).



FIG. 204.—NUT
LEAF WEEVIL
(*Strophosoma coryli*). (× 4.)

It is quite a widely distributed insect in this country, according to Canon Fowler (5). It is also referred to in Schlich's 'Manual of Forestry' by Fisher (6).

Kaltenbach refers to it as "an injurious weevil, appearing in the spring for the most part, in great numbers, and gnaws the leaves of hazels," etc. (p. 590) (3).

Taschenberg (p. 103) says: "The beetle appears in many years in great numbers, not only on hazels, as might be inferred from its scientific name, but also on birch, oak, beech, Scotch fir and pine, where from May till June they feed on the buds and leaves and the bark of the young shoots, and in some localities have destroyed young trees of the above mentioned kinds."

Ormerod received them in great numbers from Great Brington, Northampton, where they with other beetles were doing great damage in 1889 to conifers.

The beetle is quite small, barely $\frac{1}{3}$ inch in length, black in colour, with grey and brown scales, dull red legs and antennæ; the elytra

with lines of minute punctures and rows of bristles between them and a black stripe at the base of the suture of the wing cases.

There are no wings.

It is important to note this insect, as in some parts it might invade our plantations from the wild hazels growing near.

REFERENCES.

- (1) *Ormerod, E. A.* 'Handbook of Insects Injurious to Orchard and Bush Fruits,' p. 118 (1898).
- (2) *Taschenberg, E. L.* 'Praktische Insekten-kunde,' II., p. 103 (1879).
- (3) *Kaltenbach, J. H.* 'Die Pflanzenfeinde,' p. 590 (1874).
- (4) *Stephens, J. F.* 'Manual of British Insects,' p. 245 (1839).
- (5) *Fowler, Canon.* 'British Coleoptera,' vol. V., p. 189 (1891).
- (6) *Schlich (Fisher).* 'A Manual of Forestry,' vol. V., p. 194 (1895).

A SAWFLY (*Cræsus septentrionalis*, Linn.) ATTACKING COB NUTS.

The large larvae of this sawfly may often be noticed in nut plantations and in gardens.

Mr. G. H. Buley of Woodnesborough sent on the 7th of August, 1905, a number of sawfly larvae, which he said he had noticed "ravenously devouring the foliage of cob nuts; about ten of them had completely stripped several boughs, and if they should increase, I fear they will destroy the lot."

They proved to be *Cræsus septentrionalis* of Linnaeus.

The same species was found doing considerable damage near Maidstone in 1904, and was also observed at Kingston-on-Thames in 1889, where it attacked filberts until they were completely defoliated. The larvae are subject to a very large number of parasites, and it is probably on this account that it so seldom occurs for two or more years in succession. At times, however, it is very injurious, and attacks nuts of all ages. Besides cob, filbert and hazel nuts, it feeds upon birch, aspen, poplars, willow, osier and the mountain ash.

Stephens records it from the gooseberry, which was considered doubtful by Cameron. They very frequently do so, especially when gooseberries are grown beneath untrained cobs or filberts, as in gardens.

SYNONOMY.

This insect has been referred to under the following generic and specific names:—*Tenthredo septentrionalis*, Linn.; *Tenthredo largipes*,

Retz.; *Nematus septentrionalis*, Olivier; *Nematus laticrux*, Villaret; *Cræsus septentrionalis*, Leach; *Cræsus laticrux*, Stephens.

LIFE-HISTORY AND HABITS.

The sawfly appears in May and June, usually at the beginning of the latter month.

It varies in length from a little less to slightly more than $\frac{1}{2}$ inch. In colour it is black, shiny and covered with dense pubescence; the

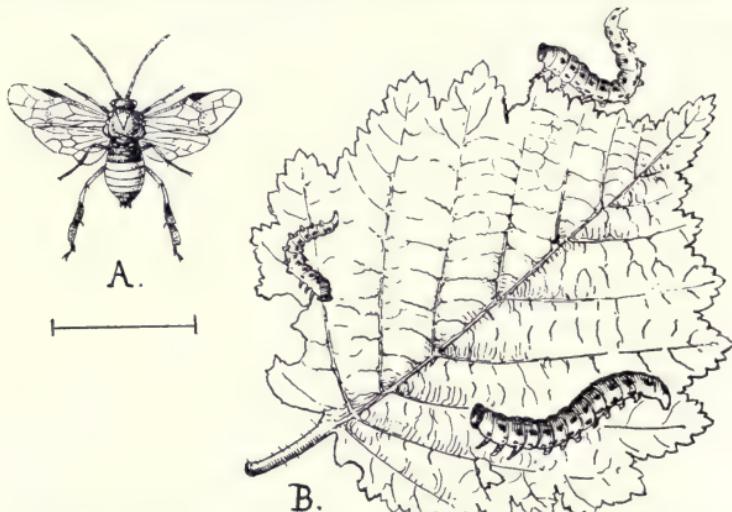


FIG. 204A.—THE NUT SAWFLY (*Cræsus septentrionalis*. Linn.). A, adult; B, larvae.

abdomen has the two basal and two or three apical segments black, the rest brick-dust red. The legs are peculiar, the posterior pair being long, the apex of the tibiae being dilated, flattened and hollowed on the inner side, metatarsus also dilated and flattened on the upper side (which is curved), and the metatarsus is much longer than all the other segments put together; the second segment is as long as the two succeeding. In colour the legs are black, the coxae and trochanters white, also the base of the hind femora, anterior tibiae and tarsi, and half the posterior tibiae mainly white; the apex of the anterior femora brown beneath, anterior tibiae and tarsi reddish at the apex, base of mid tarsi reddish.

The male differs from the female in having the femora red, the apex of the posterior femora black above; mouth and tegulae reddish. The femora are often jet black. Wings hyaline, but coloured on part

of the surface and on the apex. The eggs are laid in small slits in the veins of the leaf.

The larvae are found in July and August (and according to Cameron to the end of September). The latter statement undoubtedly applies to two broods. When first hatched they are semi-transparent, and become greenish with brown head. In ten days the larvae were found to have moulted, and then they became pale yellowish-green, with the anal segment dull yellow, and two dusky stripes on the sides.

When mature the larva is greenish-blue, and the second and anal segments bright yellow; over each spiracle, which is dark, is a dusky spot; below each spiracle, one large and two small dark spots, and over the legs four black spots and some lines. The cerci are black, and on the anal segment is a black spot of rough triangular shape. The legs are greenish-grey with brown apices, and the prolegs pale green. On the venter of the fifth, seventh, eighth and ninth segments is a large yellowish gland, and a smaller one on the fourth and tenth, which can be protruded at will. The larvae feed in groups of three to ten, usually in a row near or on the edge of a leaf, and hold on by their true legs, the body being turned into all manner of shapes and freely swung over the attached portion.

When mature they fall to the ground and spin a brown cocoon of a long form, and somewhat parchment-like formation, and then they pupate. From these pupae a second brood appears in August, and lay their eggs just as the first. The imagines have been seen as early as the 2nd of August. The larvae of the second brood all remain in the larval state during the winter and pupate in the spring.

Mr. Buley has definitely traced two broods (2). The second brood went to earth in September.

NATURAL ENEMIES.

Numerous Ichneumon and other parasites attack this sawfly. None have been bred from specimens collected in Kent, Surrey or Cambridgeshire. Cameron gives the following list: *Tryphon gibbus*, Ratz.; *Mesoleius melancholicus*, G.; *M. septentrionalis*, Ratz.; *M. sexlitatus*, Grav.; *Polysphinctus areolaris*, Ratz.; *Mesoleptus testaceus*, Gr.; *Pimpla angens*, Gr.; *Ichneutes reunior*, Nees; and *Microgaster alvearius*, Spin.

GEOGRAPHICAL DISTRIBUTION.

In Britain I have found or received larvae from Hereford, Warwickshire, Kent, Surrey, Middlesex, Hampshire, Devon and Somerset.

Abroad it occurs in all the northern European States, Germany, France and Italy.

TREATMENT.

Spraying with hellebore wash or arsenical wash when the larvæ are abundant is certainly advisable in nut plantations when the young larvæ are at first seen, as they cause great havoc, and the parasites mentioned above do not do any good until all the damage is done.

REFERENCES.

- (1) *Theobald, F. V.* Report on Economic Zoology for year ending April 1st, 1906, p. 42 (1906).
- (2) *Theobald, F. V.* Report on Economic Zoology for the year ending April 1st, 1907, p. 60 (1907).
- (3) *Cameron, P.* 'A Monograph of British Phytophagous Hymenoptera,' vol. II., p. 35 (1885).

THE NUT CATKIN MIDGE.

(*Cecidomyia coryli*. Kalt.)

The male catkins of the filbert, cob and hazel nuts are often attacked by the small maggots of one of the gall-flies or Cecidomyiidae.



[W. H. Hammond.

FIG. 205.—MALE CATKIN OF NUT ATTACKED BY CECID LARVÆ.

The mature insect I have been unable to breed so far, nor do I know of any description of it. It is not recorded by Verrall (1), yet it is widely distributed, being very abundant in Kent, Sussex, Middlesex, and I have found it in Herefordshire and Devon.

The damage done by it does not appear to be generally very serious, but Mr. Hammond of Canterbury wrote me in 1899 that it was so abundant in that part of Kent that it could be found on every nut tree in large numbers.

Weitenweber (2) and Kaltenbach (3) refer to it in Germany.

REFERENCES.

- (1) *Verrall, G. H.* 'List of British Diptera' (2nd ed.), p. 7 (1901).
- (2) *Weitenweber.* 'Lotos,' p. 143 (1868).
- (3) *Kaltenbach, J. H.* 'Pflanzenfeinde,' p. 637 (1874).

THE NUT BUD MITE.

(Eriophyes avellana. Nalepa.)

This mite was first observed by Dujardin (3) in 1851. Until the last few years but little importance has been attached to this acarus, which is a mite closely related to, but quite distinct from, the Big Bud Mite of the black currant. Normally its host is the hazel, but for some years it has been noticed on filberts and more recently it has infested the cob nut.

Mr. William Bear of Hailsham wrote in 1900 that it was becoming serious on his nuts. Mr. F. Smith of Loddington informs me it occurs on both his cobs and filberts, but does not seem to cause much harm. In my own garden a row of cobs and filberts grow adjoining a copse with many hazels. The latter are badly infested with this mite, but it has never taken to either of the former, although they even interlace with the hazels.

It is, however, undoubtedly spreading more on to the cultivated kinds.

The effect on nuts is much the same as that produced on the black currant. The buds swell in a very similar way, and either shrivel up and die or they produce mere bushy, deformed foliage.

There is no possible connection between this mite and the one infesting currants. The species are quite distinct, as shown by Nalepa. Nor will the Nut Mite infest currants. Experiments carried out in this direction have failed in every case.

LIFE-HISTORY.

The mites live much as do those on the currant. The swollen buds may be found in winter, but they do not become prominent

x 2

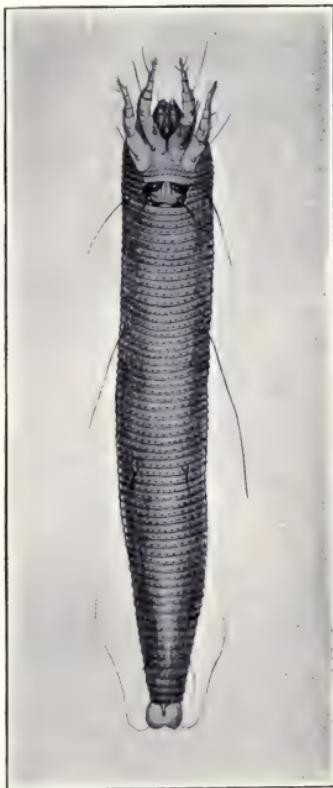


FIG. 20C.—CURRANT GALL MITE.
Compare with nut species to see difference
(p. 308).
(After Nalepa.)

until the spring. They are more flared out at the sides than those caused by *Eriophyes ribis*. Ormerod describes the galled buds (1) as drying up and falling off. I have never yet seen this; old buds of the preceding year are of common occurrence on the nut.

The mite is about 0·21 mm. in length in the female, 0·18 mm. in the male. The females lay their eggs in the buds in the same way as the currant species does, and as the old buds decay they migrate to others. In July and August a second growth becomes prominent, easily noticed by their size and often bright colouring.

The eggs I have found from March until October, more have been detected in the winter.

Nalepa's figure of the mite is reproduced here. The male is much fatter and rather broader than the female; in colour they are very similar to the

Big Bud Mite. On the back are two short bristles towards the head, followed by two long ones close to them; then are seen two long and two small caudal setæ; ventrally are three pairs of short setæ in both male and female. The ova are more hen's egg shaped than those of *E. ribis*.

Some people whose opinion is of no scientific or practical value have stated that this species and the one infesting the currant are the same, and that currants may become invaded by the Nut Mite. One has only to refer to the figure of the former to see the great difference so plainly noticeable in the bristles.

The leaf buds only are attacked at present as far as I know.

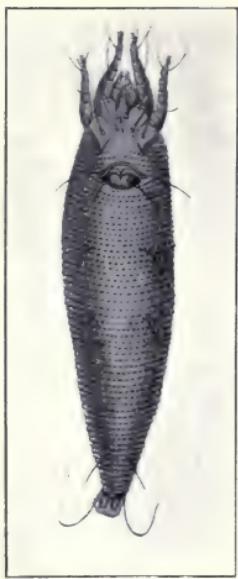


FIG. 207.—THE NUT BUD MITE
(*Eriophyes avellanae*) ♂.
(After Nalepa.)
(Greatly enlarged.)

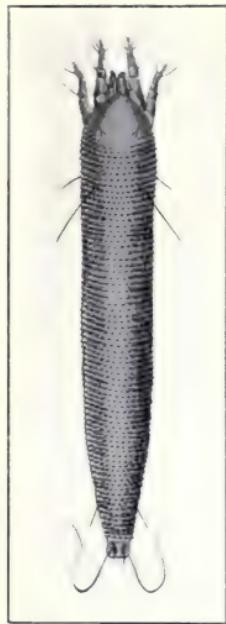


FIG. 208.—THE NUT
BUD MITE ♀.
(After Nalepa.)
(Greatly enlarged.)

PREVENTION AND REMEDIES.

It is well for those who intend planting up nuts to bear in mind that this pest is common in hazel copses and in hazels on hedgerows, and to avoid planting near the former, and where possible to remove all hazels in the hedgerows near their plantations. Starting with clean stock is very essential, as at present there is no known remedy for these bud mites. The lime and sulphur dusting having proved of little value for the currant, it is not likely to be of any more use in this case and more difficult to apply. All growers can do is to hand-pick the swollen buds, a much more difficult task than in the case of currants.

REFERENCES.

- (1) *Nalepa, Dr. A.* 'Beitrage zur Systematik der Phytopten,' p. 126, Taf. II. and Taf. III. Wien (1889).
- (2) *Ormerod, E. A.* 'A Handbook of Insects Injurious to Orchard and Bush Fruits,' p. 116 (1898).
- (3) *Dujardin.* 'Annales des Société Naturale' (1851).
- (4) *Frauenfeld.* 'Verh. Zool. and Bot. Gesel in Wien,' XV., 895.
- (5) *Amerling, Dr.* 'Lotos,' p. 44 (1863).

II.—TO SPANISH CHESTNUT.

THE NUT FRUIT TORTRIX.

(*Curpocapsa splendidana.* Hb.)

This moth, which is closely related to the Codling Moth, is by no means of common occurrence in this country, but it is fairly widely distributed in the south of England.

Normally in this country the larva is said to feed on acorns. In 1890 I found it in some numbers at Ninfield, in Sussex, amongst Spanish chestnuts, and found later that it attacked the fruit (4).

On two occasions in 1884 I noticed maggots in walnuts on the trees, but not until 1904 could I trace any appreciable damage done by them (1). The specimens were bred out and proved to be this insect beyond doubt. During the late autumn of the same year several samples of walnuts were sent me containing the same larvæ. At Interlaken, in the Bernese Oberland, I noticed a similar attack in 1889.

In 1906 attention was called (2) to the numbers of the maggots of this moth introduced in Spanish chestnuts. Some were actually found crawling in the street of a Kentish village.

The importation of this insect is certainly not wise, and growers who have chestnuts or walnuts should be very careful in keeping a look



[Horace Knight.

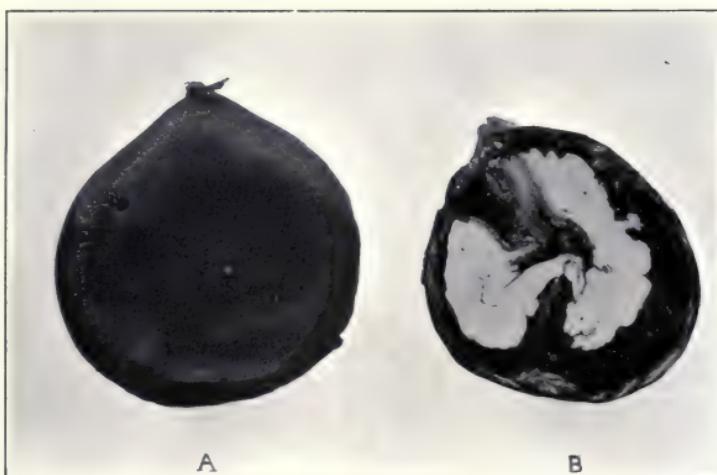
FIG. 209.—CHESTNUT AND ACORN MOTH (*Carpocapsa splendidana*).

out for these insects in local stores, and try and get the infested stuff destroyed in some way, as at present it is not a pest in this country.

LIFE-HISTORY AND HABITS.

The moth appears in June and July and lays its eggs on the young fruit.

In size it is from $\frac{1}{2}$ to $\frac{2}{3}$ inch across the wings. The fore wings



[F. Edenden.

FIG. 210.—SWEET CHESTNUTS ATTACKED BY MAGGOTS OF *Carpocapsa splendidana*.

A, shows exit hole ; B, damaged interior.

are whitish-grey, the basal patch grey, its outer edge angulated, streaks of grey along the costa, at the hind margin is a large blackish-brown area enclosing a silvery-edged ocellated patch, in which are three or four black longitudinal lines.

In ten days the eggs hatch and the maggots enter the young fruit.

The larvae are pinkish-white, with the head and first segment brown and are about the size of the Codling Maggot, but not so fat. Specimens received from foreign Spanish chestnuts were all dirty yellowish-white, one only showing traces of pink.

They leave the fruit, when mature, by a remarkably small hole, one larva under observation taking half an hour to escape.

Pupation takes place in the same manner as is done by the Codling Moth. Larvae occur as late as the 31st of November, and in December in imported nuts.

Observations made in 1894 showed that they crawl up the walnut trees, spin a dirty white silken cocoon, and pupate in the spring. Morris(3) says they pupate in a brown cocoon in moss. Cocoons are also found in rough grass beneath the trees, and some larvae remain in the nuts all the winter, leaving them in February.

Should this moth become a serious nuisance in walnuts or chestnuts the banding found so successful for Codling Moth might be adopted.

The importation of this insect is a matter that must not be forgotten, and is certainly attended with some danger.

REFERENCES.

- (1) *Theobald, F. V.* 'Notes on Insect Pests in 1894,' p. 21 (1895).
- (2) *Theobald, F. V.* Report on Economic Zoology for year ending April 1, 1907, p. 61 (1907).
- (3) *Morris, F. O.* 'British Moths,' vol. III. (1872).
- (4) *Theobald, F. V.* The Animal Pests of Forest Trees, p. 31 (1904).

THE LEAF BOX BEETLE.

(*Attelabus cœulionides.* Linn.)

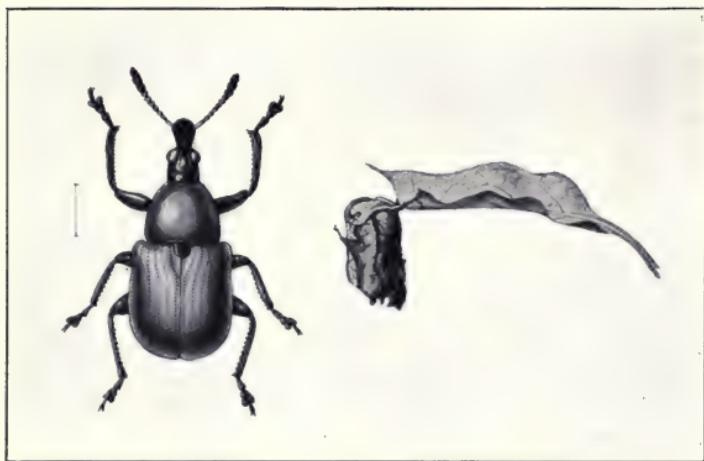
This local yet widely distributed beetle is often very abundant in Europe. It is a weevil, which at times occasions not only much disfigurement to young oak trees, but also attacks the edible or Spanish chestnut in the same way.

Fisher in Schlich(1) refers to it as locally common on oak and sweet chestnut, chiefly on undergrowth.

The beetle appears in June. The female cuts and rolls the end of a leaf into a short, stout cylindrical box, which may be doubled

over the leaf or standing away from it. This leaf box is held in place by the mid rib, which is not touched by the beetle. In length this case is about $\frac{1}{2}$ inch and rather more than $\frac{1}{4}$ inch in diameter. As many as fifty have been counted on one small branch of a chestnut. It is formed by the female cutting a transverse incision about half-way down the leaf to the mid rib, the cut terminal part is then rolled into the box. In each case before it is rolled up, the female deposits an orange ovum, which hatches into the larva in a week or ten days.

The bright orange egg is easily seen; one only is placed in each



(Horace Knight.

FIG. 211.—LEAF BOX BEETLE (*Attelabus cucullionides*) AND LEAF NEST.

box. The maggot feeds inside this chamber and pupates there, either when on the tree or on the ground.

The beetles may occur early in May, but the majority do so in the first two weeks in June.

The colour is bright brick-dust red; the head being black and also the scutellum, both thorax and abdomen are very finely punctate, the legs are dark brown and the tibiae dentate on their inner side. The male differs from the female by having a single curved hook at the apex of the front tibiae and reddish hairs on the abdomen; the female has two curved hooks on the apex of the front tibiae and a smooth body. The length varies from $\frac{1}{3}$ to $\frac{1}{4}$ inch.

The hazel and hawthorn also serve as food plants.

It is very common in Kent and many of the midland counties, and is especially abundant at certain times in the Forest of Dean.

When very abundant on the sweet chestnut the boxes should be collected and burnt, if on young trees.

On old ones it does but little harm.

REFERENCES.

- (1) *Fisher-Schlich.* 'Manual of Forestry,' vol. V., p. 193 (1895).
- (2) *Theobald, F. V.* Animal Pests of Forest Trees. Journal S. E. Agri. Coll., No. 13, p. 185 (1904).

III.—TO WALNUT.

THE DUSKY-VEINED WALNUT LOUSE.

(*Ptychodes juglandis.* Frisch.)

This is one of our most beautiful aphides, and it is strange that such a conspicuous insect's life-history should remain still unknown. It is well figured by Buckton (1).

I observed it for nine or ten years regularly (2) working upon some large walnut trees at Kingston - on - Thames; but, although present in plenty, it never increased sufficiently to do any serious harm to the trees until 1894, when this and other pests were most destructive. The earliest note of the creature's appearance upon the walnut leaf was the 1st of July; in 1894 none were observed until the 10th of July. In all instances the form of aphis first observed upon the leaves was the winged viviparous female. The following is copied direct from my notes:—"These plant lice are always to be found on the upper surface of the walnut leaves, and in two rows close to the mid rib (Fig. 212). The winged females usually settle and fix themselves, before reproducing, in patches of fourteen to twenty, seven or ten on each side of the mid rib, with their heads invariably pointing



FIG. 212.—THE DUSKY-VEINED WALNUT LOUSE.
Nymphs on leaf and just hatched adult on
left of nymphs. (Enlarged.)

(F. Edenden.

towards the rib and towards the leaf stalk. They take up their position close together, almost touching one another at their head ends, and they alternate with one another on each side of the mid rib. As soon as they deposit a certain number of young they migrate to another leaf. About fifty larvae are deposited on each leaf, and these cling closely together in a broken row on each side. A few lice may every here and there be found on the under surface of the leaves, having been dropped by the female when crawling about. These soon get to their proper quarters, and evidently entirely repudiate the aphis custom of remaining on the under surface of the leafage." On the 17th of July, 1894, all the winged females disappeared, but left behind them hundreds of their young. As a rule, fresh winged generations soon make their appearance from those on the leaves, but contrary notes I find in 1889, when only two winged generations were observed. On the 1st of September the walnut aphis was still abundant in the pupal form, but by the 24th of that month they had nearly all turned to the winged generation, and had gone from the trees; where to could not be ascertained. There are several strange points in the life-history, structure and habits of this aphis. As far as we know, every one that hatches from the eggs which are deposited in the autumn assumes the winged state before viviparous reproduction takes place. Like *Drepanosiphum platanoides*, there is not known to be any wingless viviparous female. Unlike every other species of aphis, each young one, a so-called larva, passes directly into the pupal state, and then into the imago before any reproduction of species takes place. This modified development is of great interest. Again, it has the unusual habit of living upon the *upper* surface of leaves, and not, as is the rule amongst plant lice, upon the under surface.

DESCRIPTION.

The pupa is long, oval, yellowish; with pale testaceous head and two rich reddish-brown irregular spots; four spots on the prothorax. Abdomen with four rows of dark spots, squarish in shape, so placed as to form almost transverse bands—the middle pair of spots in each segment are elongated and now and then almost unite, there is a very small dark spot or dash above each spot in the central area—nine spots in each central row with a vestige of a tenth in front, last segment but one of abdomen with one large dot, nearly covering it; apex slightly hairy. Eyes dark red. Antennæ short, distal segments dark. Rostrum very short, sometimes shorter than the head. Wing cases prominent, pale yellow, edged with purplish-brown. Legs pale yellow, tarsi dark and also the distal ends of femora in the posterior

pair. (Buckton says the legs are pale grey. I have not, however, come across any of this colour.)

The winged viviparous female is large and bright greenish-yellow; head, prothorax, thoracic lobes and metathorax brown; head slightly hairy. Pale yellow in centre of prothorax. Abdomen yellowish-green with seven well-defined dark brown dorsal stripes, one on each segment and a small eighth one often seen at the posterior end, two lateral lines of eight brown spots, one at each end of the dorsal stripes; sides of the abdomen slightly cottony; ventral surface of the abdomen bright shiny yellow. Antennae short and slender, the seventh segment being represented by an obtuse claw or nail. Proboscis greenish-yellow, scarcely coming below base of first pair of legs. Eyes red. Legs shortish and hairy, anterior pair pale yellow, tarsi slightly darkened, distal end of femora also dusky; third pair with very dark ends to femora, ends of tibia and tarsi also dusky. Wings small and narrow for the size of the body; costal and cubital veins brown, stigma pale brown, all other veins brown, expanded into brown stains at their ends; base of the wings yellowish.

The young from the winged female are at first pale yellow, but they soon become darker, with brownish head and thorax and four rows of dark dots down the abdomen, two central and two lateral, about twelve in number, but subject to variation. Antennae short and legs very pale, looking almost silvery grey against the green leaves of the walnut, except the tarsi, which are dark brown. In about ten days they reach the pupal stage, the wing cases gradually appearing.

DAMAGE DONE.

In July 1894 I noticed damage done by these lice. A note in my diary reads as follows:—"The lice seem to have already done some harm (July 10th), as the affected leaves look sickly and are blotched with yellow and are pallid at their tips, and generally present an unhealthy appearance. The lice stick their proboscis into the mid rib itself, and not into the soft lamina. Many of the nuts on the trees affected with this and the next aphid are now falling, and I fancy the cause is undoubtedly the plant lice destroying the leafage." Later on, in August and September, the aphides rapidly increased and caused a scorched appearance amongst the leaves, hundreds of sound-looking nuts continuing to fall, the cause undoubtedly being the insect attack here described.

ANOTHER FOOD PLANT.

Late in September 1894 I found another plant upon which this aphid lived. On the 22nd of that month I noticed a few

winged females, which on examination proved to be this walnut louse, upon privet leaves in a hedge surrounding the area where one of the affected walnut trees grew. They remained feeding upon the privet leaves until the 1st of October, when one and all died without producing any oviparous generation.

Such, briefly, are the facts concerning this walnut pest as far as we know. Whether any wingless viviparous female does exist, and where the winter quarters and where the early life (for it does not as a rule appear on the walnut until the beginning of July or the end of June) of this species are spent we at present do not know. I believe from occasional observations, however, that fuller investigations will show that *P. juglandis* spends its time, before the walnuts are in proper leaf, upon the privet, and returns to that plant again in the autumn, just as the hop louse migrates from the sloe and plum to the hop in the early summer, and back to those prunes in the autumn.

I have found this *aphis* in plenty on walnuts at Wye, but not sufficient to do any damage, also at Taplow, Cambridge, Worcester, and in some places in S. Devon.

REMEDIAL MEASURES.

As to checking the increase of this pest, little can be done upon trees when they are large. The lower branches and the small trees were sprayed as high as possible, some with creolin, soft soap and water, others with quassia, soft soap and water, both washes being equally successful, as far as the destruction of the aphides went; but there were constant migrations downwards from the high boughs, so that it was almost impossible to check them.

REFERENCES.

- (1) *Buckton, G. B.* 'Monograph of British Aphides,' vol. III., p. 40 (1880).
- (2) *Theobald, F. V.* Notes upon Insect Pests in 1894, with especial reference to Insects attacking the Walnut, p. 15 (1895).

THE COMMON WALNUT LOUSE.

(*Pterocallis juglandicola.* Kalt.)

This species is nearly always found on walnut trees, and can be readily distinguished from the Dusky-veined *Aphis* by its abode being on the under surface of the leaf and by its clear wings. It turns

the leaves a sickly yellow when present, as it is in some seasons, in very large numbers. Winged and wingless females are found to produce living young, unlike the former species and are seen earlier in the season. They feed near the mid rib, as does *juglandis*, but always on the under surface. Their first appearance is about the middle of May and they continue until October (1). The eggs are laid on the bark and twigs of the walnut tree. I have observed it on two or three occasions in a harmful state at Kingston, and once at Taplow.

DESCRIPTION.

The apterous female or larva is small, somewhat elongate, pale bluish-yellow. Body, hairy; hairs, capitate. Abdomen with two longitudinal rows of brown spots on the dorsum. Eyes, red. Rostrum, short.

The pupa is larger than the female. Yellow, green, and brown. Abdomen with four rows of black spots. Wing buds and legs a peculiar kind of pale greenish-blue.

The winged female is almost orange. Abdomen semi-transparent. Thorax sometimes brownish-orange. Antennæ, short; seventh segment, small; tips of segments, dusky. Legs, yellow. All the nervures, stigma, and insertions of the wings are yellow.

The oviparous female is apterous, hairy, yellowish-green, and has three black bands on the abdomen. Antennæ ringed with black. Legs, green, with isolated black spots on tips of femora. Appears in August. The male is winged and is like the viviparous female, only much smaller.

This dolphin occasionally causes much loss to the walnuts by drawing out quantities of sap from the leaves. In 1890, and again in 1894, they were very abundant at Kingston-on-Thames, but they do not seem to secrete much honeydew, and hence only do damage by puncturing the tissues of the leafage. They are particularly destructive when many appear early in the year when the walnut leaves are still tender. Notes of its occurrence have been sent me also from Great Staughton, from Worcester, and I have observed it swarming on the leaves at Wye. The wash used for *juglandis* is also of use for this louse.

REFERENCES.

- (1) *Theobald, F. V.* Notes upon Insect Pests in 1894, with especial reference to Insects attacking the Walnut, p. 17 (1905).
- (2) *Buckton, G. B.* 'Monograph of British Aphides,' vol. III., p. 32 (1880).

THE WALNUT LEAF-GALL MITE.

(*Eriophyes triseriatus* v. *erinea*. Nalepa.)

This mite causes bladder-like swellings on walnut leaves, the under surface being hollow and lined by a white, velvety substance. The acari are very minute and very transparent.

Although disfiguring to the foliage, I have never seen any real damage caused by it. This form is most common on the walnut, but the type species *Eriophyes triseriatus* now and then occurs. The galls formed by them are quite different, being in the form of brownish-red galls about the size of a pin's head, slightly projecting on the upper and under sides of the leaves. The mites appear to enter through the stomata, as in the pear-leaf species (p. 353), and may be found in the soft cellular tissue in great numbers. Some mites are brownish in appearance and only $\frac{1}{6}$ mm. in length. Formerly called *Cephaloncon bifrons*, Bremi.

REFERENCES.

- (1) Murray, A. 'Economic Entomology. Aptera,' p. 370 (1887).
- (2) Houard, C. 'Les Zoocécidies des Plantes d'Europe,' p. 111 (1908).
- (3) Nalepa, A. 'Systematik der Gallmilben,' p. 51.

PEACH.

LIST OF INSECTS, ETC., INJURIOUS TO THE PEACH.

LEPIDOPTERA.

WINTER MOTH (*Cheimatobia brumata*. Linn.). Foliage, p. 50.
 PEACH BLOSSOM MOTH (*Thyatira batis*. Linn.). Foliage, p. 419.

HEMIPTERA.

PEACH SCALE (*Lecanium persicae*. Geoff.). Wood, p. 321.
 CUSHION SCALE (*Pulvinaria vitis*. Linn.). Wood, p. 481.
 PEACH APHIS (*Aphis amygdali*. Fons.), etc. Foliage, p. 324.
 CHERRY BLACK FLY (*Myzus cerasi*. Fab.). Foliage and Shoots, p. 197.

COLEOPTERA.

THE RED-LEGGED WEEVIL (*Otiorhynchus tenebricosus*. Linn.). Foliage, p. 428.

ORTHOPTERA.

CLIMBING LOCUST (*Leptophyes punctatissima*). Shoots, p. 325.

Other aphides recorded are: *Myzus persicae*, Fons.; *Aphis amygdalinus*, Schouteden; and *Rhopalosiphum dianthi*, Sulzer.

ACARINA.

LEAF BLISTER MITE (*Eriophyes padi*. Nal.). Foliage, p. 399.
 RED SPIDER (*Tetranychus telarius*. Linn.). Foliage, p. 488.

CRUSTACEA.

WOODLICE (*Oniscidae*). Ripe fruit, p. 326.

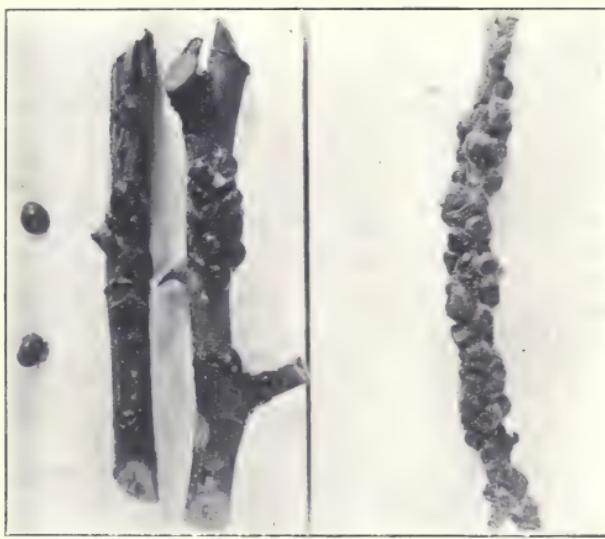
THE PEACH SCALE.

(*Lecanium persicae*. Geoffroy.)

Although found out of doors this is essentially a greenhouse pest. It is frequently very harmful to peach, apricot and nectarine, and also occurs on the vine in this country, and I have twice found it out of doors in gardens on the plum. Its food plants abroad are more varied and include the following:—*Corylus*, *Morus alba*, *Morus nigra*, *Ficus carica*, *Robinia pseudacacia*, *Spiraea* and *Lonicera*;

Magnolia glauca, *Ilex opaca*, *Elaeagnus angustifolia*, Japanese quince and Gooseberry (1 and 2).

Its distribution in Britain is wide. Newstead (1) records it from



(R. Newstead.)

FIG. 213.—BROWN SOFT SCALE (*Lecanium persicae*) ON ROSE AND PEACH.

Cheshire, Cambridgeshire, Norfolk, Gloucestershire, Herefordshire, London district, Kent and Wiltshire. I have received it from Sussex, Devon, Cornwall and Hunts. Fernald (2) records it also from Australia, Nova Scotia and the United States.



(F. Edenden.)

FIG. 214.—*Lecanium persicae*.
(Greatly enlarged female.)
(From preparation by Newstead.)

LIFE-HISTORY AND HABITS.

The adult female is dusky yellow and becomes gradually darkened with age, paler in the middle with eight or nine dark transverse bands and confluent spots, oval and hemispherical in form. The female at the period of reproduction is shiny reddish-brown with traces of the dark marking which later disappear when they become deep chestnut-brown. The eggs are laid

about the middle of May under glass, and the larvae hatch in the middle of June. As many as 2,000 eggs are said to be laid (Newstead)

by a single individual. The females reproduce without the agency of the male in this country. The larvæ are yellow or pale red when first hatched and become dark greenish to greenish-yellow or pale reddish and emit very long and fine glass-like filaments from both extremities.

They wander over the shoots and foliage where they take up their abode; Newstead finds that some may be still seen migrating in the autumn. They pass the winter as full-fed larvæ, scarcely visible to the naked eye, and moult in spring when growth becomes very rapid, and the mature female form is soon produced. The ova are almost white. The winged male has not been seen in this country. It seems to be the young tender shoots of the peach that are attacked, and there on the green wood the scale insects soon produce discoloration and the shoots die away.

Those that get on to the leaves, of course, fall with them and die.



[R. Newstead.]

FIG. 215.—THE BROWN SOFT SCALE
(*Lecanium persicæ*) ON PLUM.

TREATMENT.

The best thing in peach houses is sponging with paraffin emulsion in winter or spraying with the same. Good results have been reported of the use of caustic alkali wash. Many gardeners have told me this has been quite successful as a winter dressing.

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PEACH APHIDES.

(*Aphis amygdali*, Fons.; *Myzus persicae*, Fons.; *Aphis amygdalinus*, Schout.; and *Rhopalosiphum dianthi*, Schrk.)

At least four species of aphis attack the peach in this country, but as they have not been properly worked out, little had better be said concerning them.

They attack the foliage, and especially the tips of the shoots, and cause the leaves to curl up and fall prematurely.

According to what I have seen the common species is the *Aphis amygdali*, Fonsecolombe, which also attacks nectarines and apricots. It may be found in April and May as apterous viviparous females, yellowish in colour, variegated with browns, paler ochreous legs with brown tarsi; the cornicles are short and brown, except at the base; the pupa is green with rusty stains, and pale green wing cases and pale brown legs. The winged female is rusty yellow, with a black head and thoracic markings; the abdomen with a large dark area towards the apex and four lateral black spots and black cornicles, thickened at their bases; the legs are dark ochreous with black apex to the femora and black tarsi. One marked character is the presence of small papillæ on the last two rings on the under surface.

This aphid leaves the peach in summer and returns in autumn. It also feeds on the sloe, and Buckton has found it on the tobacco plant.

That it leaves the peach we are well aware, but its migrant habits are not fully known.

Rhopalosiphum dianthi, Schrank, also occurs on the peach, and is usually found there in late summer and autumn. It feeds upon a host of other plants, and at present we cannot say anything definite regarding it.

The wingless female is shiny green, ochreous red to brownish-yellow, with green cornicles with black tips.

The winged female has a shiny reddish-yellow abdomen with dark markings, one a large spot in the middle, some transverse lines and four lateral spots.

TREATMENT.

The only treatment necessary is spraying with soft soap and quassia, and it must be done frequently.

The use of paraffin emulsion for these insects on peach, apricot and nectarine should be discarded, as the delicate foliage cannot stand this treatment.

THE CLIMBING LOCUST.

(Leptophyes punctatissima. Bosc.)

These locusts have been recorded from Minster (1) where they were taken in numbers on peach trees and doing much harm. The *Locustidae* or true locusts are distinguished from the grasshoppers or *Acriididae* by their long antennae, by the position of the "stridulating" organ, and by the long ovipositor. From the crickets or *Gryllidae*, they can be told by their four-jointed tarsi, the crickets having either two- or three-jointed feet.

This green locust has the wings rudimentary, and may be found in the autumn crawling up various trees and shrubs. It was noticed that many were *in copulâ* on the peach trees at Minster.

This species may be identified by the following characters:— Colour, yellowish-green, covered with numerous black dots and a few dusky markings; the pronotum has two lateral pale brown streaks on the disc, bordered externally by bright yellow streaks, and also on the anterior margin. The elytra are as long as the pronotum in the male, but are much shorter in the female. Wings abortive. The ovipositor of the female broad, composed of four sickle-shaped pieces, the two lower being much broader than the upper, compressed and crenulated. The green antennæ are very long, with a few dark brown rings. The females are larger than the males; the former being 18 mm., and the latter 14 mm. in length. *Punctatissima* appears from July onwards until October, the majority occurring in August and September. The young larvæ are much paler than the adults, and grow gradually into the mature form. The imago really remains in the pupal stage, no true winged form occurring. At least six moults seem to take place during growth. It is a fairly common insect in this country, especially in the south-east. I have also seen it in numbers in Huntingdonshire and North Wales, and it occurs now and again in plenty on brambles and plum trees as well as wall peaches at Wye. Shaw (2) records it from Hastings, Plumstead, Herne Bay, Bromley, Polegate, Wimbledon, Dartford and Combe Martin. It is also said to be common at Penmaenmawr. In some parts of Wales I have seen numbers crawling about brambles growing in hedges. Its European distribution is also wide, the following districts being recorded by Wattenwyl (3): Paris, Fontainebleau, Belgium, Brabant, Spa, Zealand, Bornholm, Kissengen, Voltaggio, Zurich and Schonen. It does not appear to be found in North Germany nor in Austria.

These locusts only appear now and again in sufficient numbers

in our gardens to do any appreciable damage, but they devour in all stages the foliage of such fruit as peach, apricot, nectarine and plum, with great rapidity, and may occasion some harm when present in numbers, especially to peach and nectarine.

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- (2) *Shaw, E.* Synopsis of British Orthoptera. Entomologists' Monthly Magazine, vol. XXVI., p. 58 (1890).
- (3) *Wattenwyl, C. B.* 'Prodromus der Europäischen Orthopteren,' p. 286 (1882).

WOODLICE.

(Oniscidae.)

When peaches, apricots and nectarines are just ripening, both out of doors and indoors, woodlice frequently attack them. The commonest forms seem to be *Oniscus ascellus* L., and *Armadillidium vulgare*, Lat.

Woodlice are best trapped by placing scooped-out oranges or potatoes near the trees, or by filling pots with damp moss or fresh horse manure. Fumigation with hydrocyanic acid gas has also been found to kill them under glass. They love moisture and decaying wood, and are usually worst in old glass-houses.



[F. E.]

FIG. 216.—A WOODLOUSE.

(x 2.)

REFERENCE.

- Webb, M. F.* 'The British Woodlice,' pp. 27 and 41 (1906).

PEAR.

INSECTS, ETC., INJURIOUS TO THE PEAR.

LEPIDOPTERA.

- LARGE TORTOISESHELL BUTTERFLY (*Vanessa polychloros*. Linn.). Foliage, p. 186.
 WOOD LEOPARD (*Zeuzera pyrina*. Linn.). Wood, p. 46.
 GOAT MOTH (*Cossus ligniperda*. Fab.). Wood, p. 42.
 LACKEY MOTH (*Clissicampa neustria*. Linn.). Foliage, p. 30.
 VAPOURER MOTH (*Orygia antiqua*. Linn.). Foliage, p. 38.
 WINTER MOTH (*Cheimatobia brumata*. Linn.). Foliage and fruit, p. 50.
 MOTTLED UMBER MOTH (*Hybernia defoliaria*. Clerck.). Foliage, p. 58.
 TORTRIX (*Tortrix sp.?*).
 CODLING MOTH (*Carpocapsa pomonella*. Linn.). Fruit, p. 69.
 PEAR LEAF BLISTER MOTH (*Cemostoma scitella*. Zell.). Foliage, p. 330.

COLEOPTERA.

- FRUIT BARK BEETLE (*Scolytus rugulosus*. Ratz.). Bark, p. 111.
 APPLE BLOSSOM WEEVIL (*Anthonomus pomorum*. Curtis). Blossom, p. 104.
 RED-LEGGED WEEVIL (*Otiorhynchus tenebricosus*. Herbst.). Foliage, p. 428.
 LEAF WEEVILS (*Phyllobius oblongus*, Linn., and *P. maculicornis*, Germ.). Foliage, p. 119.

HYMENOPTERA.

- PEAR SLUGWORM (*Eriocampa limacina*. Cameron). Foliage, p. 334.
 SOCIAL PEAR SAWFLY (*Pamphilus flaviventris*. Cameron). Foliage, p. 338.
 APPLE SAWFLY (*Hoplocampa testudinea*. Klug.). Fruit, p. 122.

DIPTERA.

- THE PEAR MIDGE (*Diplosis pyrivora*. Riley). Fruit, p. 343.
 PEAR LEAF CURLING MIDGE (*Cecidomyia pyri*. Bouché). Foliage, p. 350.
 SCIARA MIDGES (*Sciara spp.*), p. 351.

HEMIPTERA.

- THE WOOLLY APHIS (*Schizoneura lanigera*. Hausm.). Roots, trunks and boughs, p. 141.

HEMIPTERA—continued.

APPLE APHIS (*Aphis pomi*. De Geer). Foliage, p. 130.

PEAR APHIDES (*Aphis pyri*, Fons., and *Aphis pyraria*, Passerini).
Foliage, p. 352.

MUSSEL SCALE (*Lepidosaphes ulmi*. Linn.). Bark, p. 165.

PEAR PSYLLE (*Psylla simulans*, Forst, and *P. pyricola*, Forst).*

THYSANOPTERA.

THE PEAR THIRPS (*Thrips physopus*, Linn., and *T. flava*, Schr.).
Blossoms and foliage, p. 352.

ACARINA.

PEAR LEAF BLISTER MITE (*Eriophyes pyri*. Nalepa). Foliage and
Fruit, p. 353.

THE PEAR LEAF BLISTER MOTH.

(*Cenostoma scitella*. Zeller.)

Although not of very serious nature this small microlepidopteron requires notice, for now and again, in widely separate localities, it causes harm to the pear and apple. The first instance of damage done by it was brought to my notice in 1898 from two widely separate localities, namely, in East Lothian, N.B., and in Cambridgeshire.

In the former county this pretty little moth appears to have been destructive for several years previously.

The Rev. John Hart of Aberlady sent me specimens, as well as his notes on the damage done. Mr. Charles Barrett kindly corroborated the identification.

The same insect, Mr. Hart wrote me, was doing much harm to pear and apple trees in the Duke of Buccleuch's gardens at Dalkeith, and also at Lord Wemyss's in the same district. In the same year I was called to see many trees in and near Cambridge attacked by this insect, and nearly every leaf on some of the trees was found to be ruined by the larvae.

In 1903 specimens of damage were sent me from Great Staughton, in Huntingdonshire, and the trees were later examined and the leaves found covered with the mines; apples were mainly attacked. One of the worst attacks I have seen was at Eardiston, in Worcestershire, where Mr. Ballard had a large pear tree with the foliage completely covered with the blisters and quite blackened when I saw it in August 1906. In the previous year it occurred in large numbers in

* *Vide 'Hemiptera-Homoptera of the British Isles.'* James Edwards, pp. 239-241. Psylle are rare on cultivated pears.

my garden at Wye, and quite destroyed the foliage of two young Cox's Orange Pippins. The attack seems to be well known to gardeners in many parts of the country, but does not seem to affect plantations to any great extent.

Stainton (2) says: "In the neighbourhood of London it is excessively abundant, and from the profusion of the mines of the larvæ, the hawthorn hedges will in August assume quite a brownish tinge." It is also mentioned by Curtis (3) and by Westwood (4) and earlier by Knight (*Horticultural Transactions*), whose trees were so injured that he at one time resolved to remove them. In 1775 Goeze (5) gave a description of what is evidently this species mining the leaves of apple and pear trees in Germany.

It is also recorded from Northumberland, Durham, Lancashire, Yorkshire, Cheshire, Warwickshire, Norfolk, Suffolk, Essex, Hereford, Gloucester, Dorset and Wilts (1).

In a copy of the *Cottage Gardener* for May 1849 (6), I find a reference to an insect that is evidently *C. scitella*. "Every gardener," it says, "must have observed the leaves of his pear trees, especially those of the Chaumontelle, blotched with dark brown spots in the autumn. We had a standard tree of this variety that annually was thus injured, whilst a Swan's Egg and Easter Bergamot close by were comparatively untouched. The brown blotches were caused by the caterpillars of a very small moth called the Pear Tree Blister Moth (*Tinea clerckella*)."⁷ The figure is that of *C. scitella*, but the colour is given on the fore wings as being orange with a silvery spot on the outer edge and a mingling of black, lilac and purple on the inner angle; an orange feathery



[F. Edenden.]

FIG. 217.—APPLE LEAF BLISTERED BY THE LARVÆ
OF *Cemostoma scitella*.

mark and four black lines mark their upper surface, and they have a white fringe around them.

The figure, however, clearly indicates this species.

In the attack at Aberlady the damage seemed at its zenith towards the end of July, and it continued until the end of the month at Cambridge.

Mr. Hart noticed that it was mainly wall trees that were attacked, especially near ivy-clad walls and clumps of evergreens. Stainton also refers to it on the trees at the sides of his house. This I also noticed in 1887 at Kingston-on-Thames (1) as well as at Eardiston.

Although most varieties of pears seem to be attacked, the Jargonelle and Doyenne de Comice have been particularly mentioned.

The larvae produce more or less regular round blotches, chiefly on the upper sides of the leaves, every now and then one is visible from beneath. The blisters may reach $\frac{1}{2}$ inch in diameter. The mines are at first brownish and then turn dark purplish-brown to black and marked outwardly by dark concentric rings formed by the excreta of the larvae. The leaves eventually decay away and fall off.

LIFE-HISTORY AND HABITS.

The moth appears at the end of April and beginning of May. The blisters were first noticed by Mr. Hart in East Lothian in May.



[W. Hammond.]

FIG. 218.—LARVA OF *Cemostoma scitella*.

(Greatly enlarged.)

Then again in June and July and into the first week in August. Mr. Eustace Banks told me he has bred this species in June from larvae found in the previous autumn, and also in May and June from larvae found in September. The moth has leaden-grey fore wings with a brownish-grey streak running from the costa obliquely across the wing;

two white streaks also run from the costa, nearer the tip, separated by a coppery band, which runs half across the wing; beneath these is a black spot with a violet pupil, the fringe is dingy with four radiating dark lines; hind wings leaden-grey with pale grey cilia. Wing expanse $\frac{1}{4}$ inch.

The eggs are laid on the underside of the leaves.

The larvae on hatching enter the leaf from the lower surface. At

first they are white, but become greenish when half grown, with a darker green dorsal line.

There are four pairs of curious lateral processes. Length when mature about $\frac{1}{4}$ inch.

When mature they crawl out of the leaves, and in August and September they spin a cocoon in various crevices on the trees and even on the soil.

The cocoons, of pure white silk, are pointed at each end, and are edged with loose white threads; there may be a distinct ridge along the middle. The pale brown pupa is somewhat flattened. The insect remains in this stage all the winter.

Besides apple and pear, this Tineid also occurs on sloe, hawthorn and mountain ash.

PREVENTION AND TREATMENT.

At present there is little that can be said under this heading. Mr. Hart found spraying with paraffin and soft soap of no use, but he wrote to me that, after using arsenate of lead, "the attack has not been bad, though after the creature has got between the two layers of the leaf, I venture to think it is safe."

"But just before the egg is deposited on the back of the leaf, and especially if still there, I think it is effectual."

As soon as the little moths are seen we should spray with this wash. Heavy dressings of soot and lime under attacked trees has been found of service, and in gardens hand-picking the mined leaves should be undertaken.

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- (3) *Curtis, J.* Gardeners' Chronicle, vol. I., p. 261.
- (4) *Westwood, J. O.* Gardeners' Magazine of Botany, vol. III.
- (5) *Goeze.* 'Naturforschr.,' vol. V., p. 62 (1775).
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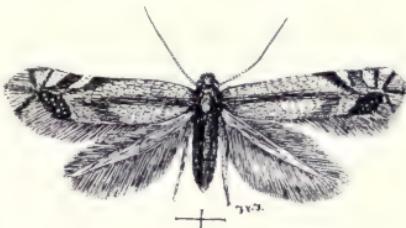


FIG. 219.—PEAR LEAF BLISTER MOTH
(*Cemostoma scitella*).

THE SLUGWORM OF THE PEAR AND CHERRY.

(*Eriocampa limacina*. De Geer.)

The records of this pest doing damage all show that it is most abundant in August, September and October.

No damage has so far been recorded as caused by these repulsive-looking larvæ earlier in the year in Britain.

Cameron (1) states: "The usual time for the appearance of the larvæ is about the middle of June, and from that time onwards they are in more or less abundance to the end of September or even October."

In America the sawfly is double brooded, "the first brood appearing on the wing in the Northern States and Canada from about the third week in May until the middle of June," the second brood occurring about the second week in July (2). I have found in England, as in America, two distinct generations; the first brood may do harm, but not as much as the second, for they are fewer in numbers. This sawfly is extremely erratic in appearance. The "slugworms" suddenly seem to appear on a tree and as often rapidly vanish when they are mature, and no signs may be seen of them again for years. Yet in a neighbouring orchard they may appear year after year. Their attack is of frequent occurrence in most parts of England. In 1875 this insect seems to have occasioned much loss in various districts in England. In 1881 it was not only very destructive in England, but



[W. H. Hammond.
FIG. 220.]

PEAR AND CHERRY SLUGWORM (*Eriocampa limacina*).
ADULT SAWFLIES AND DAMAGED LEAF.

also in Scotland. Whitehead (3) mentions its ravages in Gloucestershire, Herefordshire and Yorkshire. Ormerod (4) records attacks in 1883 at Streatham and Sittingbourne, and again in 1887 in Northumberland, Yorkshire, Glamorganshire and Surrey.

Reports of its damage have reached me during the last seventeen years from Cambridgeshire and Somersetshire, and from many places in Kent and Surrey. In all cases these have been autumnal attacks. In the Sittingbourne area it seems to be fairly persistent; Mr. Lewis Levy wrote in 1903 that it had been bad at Borden Hall for some years and seemed to persist. It has been recorded in America as *Selundra cerasi*. Peck (5) wrote regarding this slugworm in 1790. In Europe it has been well known for over 150 years, Réaumur describing it as *la Tenthredine Limace*. Both John Curtis (6) and Westwood, (7) in 1848, wrote upon the "slugworm," but since then little of value has been added to our knowledge of it except by Cameron (1).

It is also found in New Zealand and at the Cape.

The trees attacked by it are mainly cherry and pear; the morello is very badly attacked, but we have seen all varieties infested with it. Ormerod (8) mentions it attacking the leaves of quince at Bridgend in Glamorganshire.

In America Saunders (2) refers to it on the leaves of pear, cherry, quince and plum. If it is the same as the *S. cerasi* of Peck, then it also feeds on the mountain ash, according to Lintner (9). In America it is also recorded on *Crataegus* (10). It has been found in England on *Betula*, *Quercus*, *Amygdalus*, and *Rubus* (11), as well as on pear and cherry.

The damage done by the "slugworms," or, as they are called in Gloucestershire, "snegs," a name also given to slugs in Kent, is very marked. The larvae feed on the upper surface of the foliage and leave the under skin intact, the leaves thus become blotched and spotted in an irregular manner. If many are present the foliage withers, turns brown and falls. The result may be that the trees throw out new leaves and this so weakens the tree that the crop is ruined often for two years. As a rule only one or two of these shiny slug-like larvae feed on one leaf, but more may occur and then the damage becomes very marked.

LIFE-HISTORY, ETC.

The adult sawfly is black and very shiny except the anterior tibiae, which are testaceous, the middle ones almost fuscous. The wings are hyaline, with a more or less broad smoky band in the middle. Length from nearly $\frac{1}{2}$ to about $\frac{1}{3}$ inch.

The insects appear in early June in very small numbers, and soon commence, if the weather is fine, to lay their eggs.



[F. Edenden.
FIG. 221.—SLUGWORMS.

(The one on the right at its last stage.) ($\times 2$)

Four moults of the skin seem to take place. During most of their life they are bottle-green in colour, dirty pale yellow below, very



[F. Edenden.
FIG. 222.—SLUGWORMS ON CHERRY LEAF.

shiny and disgusting in appearance; the larvae swell out on the front end; the head is hidden in a kind of hood-like mass formed

Each ovum is deposited in a semicircular slit cut by the "saws" of the female on the underside of the leaf, but now and then it seems to be laid on the upper surface. A small pale spot marks the point of insertion of the ovum.

The egg, which is white and oval, hatches in seven days. The young larva escapes in most circumstances on the upper surface of the leaf.

It is at first pale, and after a few days a dark greenish slime oozes from its skin.

by the thorax ; there are ten pairs of legs. When full grown they reach $\frac{1}{2}$ inch in length.

In the last stage the larva is yellowish, with a dry wrinkled skin. Four to five weeks is the usual period of larval life. Specimens kept under observation matured by the 5th of July. On reaching maturity pupation takes place in the earth. The larva spins a parchment-like cocoon, to which particles of soil adhere. The depth at which pupation takes place varies from 1 inch up to 3 inches.

In two weeks I have found a second brood appears, that is somewhere towards the end of July. The second brood deposit their eggs in August, and from these the main attack of "snegs" arise and continue to feed well into September and October. At Elstead, in Surrey, I found them in 1898 just falling to earth on the 15th of October.

The winter is passed in the soil in the larval condition, not as pupae.

PREVENTION AND REMEDIES.

Where individual trees are affected, in the garden, the plan of removing the surface soil in the winter and burning it will be found invariably to prevent the future appearance of this pest; but in a plantation, even where cultivated, such could not reasonably be done.

Sprinkling soot and lime under infested trees when the larvae are maturing has been said to be successful.

But a remedy will probably be found necessary in most cases. Powdered hellebore has been used with success, so also has soot and lime thrown over the trees with a sulphurator. By far the best method is to spray the trees with arsenate of lead, which is found to poison the "slugworms" very readily, and one dressing only is necessary, as it sticks for some time to the foliage. The paste form is particularly useful in this attack.

NATURAL ENEMIES.

Cameron enumerates several parasites upon the larvae of this sawfly, namely, *Erromenus fumatus*, Brische ; *Tryphon gorski*, Ratz. ; *T. ratzburgi*, Gorski ; *T. excavatus*, Ratz. ; *T. translucens*, Ratz.

On one occasion I watched the Sparrows taking them in numbers off the leaves of a cherry tree.

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THE SOCIAL PEAR SAWFLY.

(Pamphilus flaviventris. Cameron.)

Occasional inquiries are sent regarding the Social Pear Sawfly (*Pamphilus flaviventris*). Westwood (4) wrote on it in 1851. In 1889, and again in 1900, there seems to have been a considerable amount of this pest about in the south and south-east of England, in some cases considerable damage to pear trees has been caused by the larvae. The larvae are very ravenous, especially towards the close of their life. Large pear trees may be stripped of their foliage by colonies of this insect. It does not seem to be a very common annual pest, yet in certain years it causes an appreciable loss in orchards and gardens.

It is known also as the Pear Lyda or the Web-spinning Pear Sawfly.

The insect is known under a great variety of scientific names. Cameron (3) mentions the following: *Tenthredo flaviventris*, Retz.; *T. pyri*, Schrank; *T. lutescens*, Pz.; *Lyda clypeata*, Klug.; *L. sylvatica*, Newman; *L. albifrons*, Fall.; *L. fasciata*, Curtis; *L. pyri*, Zad. The insect is widely distributed in England. I have not been able to find it in Wales, and Cameron says he has not found it in Scotland. In Europe it is found in Germany, Sweden, Holland, Italy and France.

Kollar (5) wrote on this species under the name *Tenthredo haemorrhoidalis*, Fabr., and refers to it attacking the plum.

During 1889 and 1890 several "tents" existed in my garden, and I was thus enabled to make observations on them, which are recorded here, together with notes sent me by correspondents.

LIFE-HISTORY.

The adult sawfly appears in May and June, the earliest date noticed being the 10th of May, but not until nearly the end of the month did they appear in any numbers in 1889. In 1890 I took a few females as late as the 3rd of June.

The female is black; the antennæ and legs yellowish; the abdomen tawny at the apex, with a yellow triangular mark on the sides of the segments, these lateral patches being largest towards the end

*[F. Edenden.]*

FIG. 223.—TENT OF SOCIAL PEAR SAWFLY.

(One-third natural size.)

of the abdomen; ventrally are to be seen bands of yellow; the bases of the mid and hind legs are dusky; the wings transparent, with a broad smoky band below the dark brown stigma, and more or less iridescent in the sun; palpi and mandibles yellow. The male has the abdomen reddish-yellow from the second segment to the apex, and the lower part of the head yellow. They vary in length from $\frac{1}{3}$ to a little more than $\frac{1}{2}$ inch across the expanded wings.

The female lays her eggs during the bright part of the day, especially in the sun. The ova are deposited in groups of from thirty to sixty on the under surface of the pear leaves, more or less in rows; about ten in each row seemed to be the general number in those observed. They are yellow in colour, long in form, and are covered by a greasy and rather sticky substance of an oily nature. A female contains nearly 200 eggs; one kept in confinement deposited 183 in six days, but laid them in a very irregular manner. The larvæ hatched out in from seven to ten days. At first the young grubs are pale yellow or straw coloured, and at once commence to form a web, which grows in size from day to day. On the 15th of July, 1899, I found one tent nearly a foot long which contained thirty nearly full-fed larvæ, and on the same day



[Horace Knight.

FIG. 224.—SOCIAL PEAR SAWFLY (*Pamphilus flaviventris*).

another nest was observed only 3 inches long, and spun between two pear leaves and their stalks; the latter also contained thirty larvæ, all huddled together amongst a dense mass of webbing; the larvæ were about half grown.

The tent of silk is very loosely spun, but very firm and grey in colour, but it often assumes a dirty brown colour owing to the "frass" and moisture collecting in it, which gives it a very quaint appearance. The silk when first spun is rather reddish-yellow, somewhat lustrous, but soon becomes dull and pale grey. The nests are usually much wider than those of the tent caterpillars (Lackey Moth) and the larvæ are readily distinguishable. The orange-yellow larvæ (Fig. 225) have a longitudinal pale brownish stripe on each side; the head is black and polished, and there are two black spots on the second segment. On the first three segments

are three pairs of yellow claw-like legs. There are no prolegs at all, but on the anal segment are two long backwardly projecting spines, looking like antennæ. The antennæ are long. A dark green line shows down the middle of the body, caused by the alimentary canal containing the green leaf substance upon which the larvæ have been feeding.

Having no prolegs they walk with difficulty when once they have left their web, wriggling much like a worm and progressing backwards with violence if touched, much after the manner of the caterpillar of the Garden Swift (*Hepialus lupulinus*). They exude a drop of clear deep coffee-coloured fluid from the mouth and from behind the head and other parts when frightened. This fluid is sometimes quite red and clear, looking like blood. They will expel this when an Ichneumon settles upon them. Its function is evidently to frighten off such enemies. When in the webbing they wander about with much ease, usually collecting together in a group when not feeding. The larvæ never seem to actually leave the nest, but when feeding they partly expose their bodies outside the tent and devour the leaves all round. They commence by devouring the edges of the leaves and work down to the mid rib, which they generally seem to leave intact. When the leaves around the nest are all cleared they form another tent near the last and commence afresh. As many as six nests may be found on one pear tree, evidently all formed by the same colony.

There is considerable variation in the time of appearance, for in the same tree fully matured and half grown larvæ may occur. The first date of pupation observed was the 17th of July, but by August many larvæ were still alive in 1890. Roughly speaking, the larvæ take five weeks to mature. They then attain the length of 1 inch. When ready to pupate they lower themselves to the ground by a thread of silk, and at once commence to burrow into the earth to a depth of 3 to 5 inches, where they spin a thin cocoon in which they remain all the winter, and in which they pupate in the spring. Miss Ormerod (1) says they do not form a cocoon, but make a smooth cell in the earth; this is contrary to other observations (2).

The pupæ seem to be able to suspend development, and may live



[F. Edenden.]

FIG. 225.—LARVÆ OF SOCIAL PEAR SAWFLY.

over to another season in the ground. This accounts for the sawflies often appearing every other year, instead of annually.

Cameron (3) says the larvæ feed on pear, plum and cherry trees, also on the whitethorn, *Mespilus* and other rosaceous shrubs. Colonies are frequently to be found on whitethorn in the hedgerows in Kent. Dwarf trees seem to be especially subject to the attack of these false caterpillars. For the last five years but few have been noticed and no inquiries have been made by fruit-growers.

NATURAL ENEMIES.

There are three Ichneumon parasites on the larvæ of *P. flaviventris*, known as *Ophion merricki*, Gr., *Ophion mixtus*, Gr., and *Tryphon armillatorius*, Gr. The two former lay their eggs in the nearly full grown larvæ, just before they enter the earth to pupate. The Ichneumon larvæ feed off the body of the sawfly grubs and then pupate, hatching out in the late spring or early summer. *O. merricki* is black, the first abdominal segment being partly black and partly red, the second and third segments red, and the last black; the hind feet are much longer than the fore feet and reddish to the knees, which are black.

These Ichneumons materially lessen the prevalence of this pest, but attacking the larvæ so late in life they do not do much good in the particular year of the attack.

TREATMENT.

If the larvæ have been allowed to develop, the ground beneath the trees upon which they have been feeding should be well dressed with gas lime during the winter, the caustic substance being worked into the soil by a prong hoe. As the larvæ do not stray from their dwelling they can easily be caught, the tent and its occupants being cut off and put into a pail of hot lime. When this is done great care should be taken to hold some receptacle beneath the tent, as the larvæ readily fall to the ground, and hang suspended by a silken cord when frightened, as they would be during the process of cutting off the tent. This is by far the best way to cope with this pest. When out of reach a good drenching with cold water or soft soap emulsion, so as to thoroughly saturate the silken house, may do a little good, but the destruction of the nest appears to be by far the most successful method of coping with it.

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THE PEAR MIDGE.

(Diplosis pyrivoræ. Riley.)

This is a very serious enemy of pear growers, and one, unfortunately, which seems to be steadily on the increase. In some districts it is so persistent in its attack that pear growing is becoming impossible.

One large grower informed me in 1898 that he would cut down all his pear trees in consequence and plant up apples, as he never got any crop owing to the "midge."

In 1906 there was some diminution in numbers in the Western and Midland counties owing to the failure of the pear crop in 1905 (7).

This small insect is a fly or "midge," belonging to the family of Gall Flies or Cecidomyiidae and to the genus *Diplosis*, in which the larvæ or maggots have curious saltatory powers.

It was described by Riley (5) as *Diplosis pyrivoræ*, but I see no reason for this, as it is evidently the same as Meigen's *Cecidomyia nigra* (1 and 2).

Nordlinger (3) describes it under the name *Cecidomyia pyricola*; Bergenstamm and Low (4) refer to it under Meigen's name, as do many other authorities.

The damage is done by the small white maggots feeding inside the young pears and destroying them.

The appearance of the infested fruitlets is very marked. About two weeks after the attack has commenced they begin to swell abnormally. The rapid growth compared with that of the sound fruitlets is very marked.

Later the fruit becomes deformed; some become round, others bulge irregularly at the sides; some become greatly elongated and constricted in the middle; in fact, all kinds of shapes are assumed by them.

On cutting open an infested pear one finds the inside more or less hollowed out and filled with black debris and small white maggots.

Later the fruitlets crack and then decay. Many fall to the ground with the maggots within them, but in certain years all the maggots escape whilst the fruitlets still hold on to the trees.

The distribution of this fly in Britain is wide. It has been reported from Sussex, Surrey, Kent, Devonshire, Herefordshire, Worcestershire, Cambridgeshire, Huntingdonshire, Dorsetshire, Somersetshire, Gloucestershire, Cumberland and Carnarvonshire by various correspondents. Ormerod (6) records it from Norfolk, Lancashire and



[F. Edenden.]

FIG. 226.—PEAR FRUITLETS ATTACKED BY PEAR MIDGE.

Cardiganshire; and Carpenter (20) from Ireland. On the Continent it is widely distributed, and it also occurs in the United States (5, 11, 15, 19), where it is thought to have been introduced from France in 1877.

All varieties of pears seem to be attacked, both the fine dessert and the coarse perry pears suffer alike. The latter trees, which grow to a great height in Worcestershire and Herefordshire, are attacked all the way up, just as much as small bush trees. Mr. Ragg reports from Reigate that all varieties are attacked there, save an old-

fashioned kind called the "Honey" and Beurre Easter, whilst Glou Morceau and Comice are but rarely invaded.

In some places it is only a tree here and there that is attacked; in others, as at Reigate, Mr. Ragg informs me every garden in the neighbourhood is similarly invaded, and that the pest appears to have been enjoying itself in the neighbourhood for years, and in many gardens there is scarcely a sound pear (7).

The Pear Midge does not seem to have attracted much attention until late years in this country. Notice was drawn to it by my old friend the Rev. E. N. Bloomfield of Guestling who had a bad attack of it in his garden in 1887 and 1888 (8).

But Ormerod (6) says "since 1883 it has been a regular pest"; nothing, however, was written about it of any account until Mr. Bloomfield's paper appeared.

Kollar (9), quoting Schmidberger, refers to it in Germany in his usual clear and precise way, and it seems Dr. Fitch was acquainted with it in America in 1847, in spite of the supposed introduction in 1877 from France.

As far as we know the pear only is subject to the attack of this pest.

LIFE-HISTORY, ETC.

The midge varies from $\frac{1}{10}$ to $\frac{1}{8}$ inch in length. The male is dark blackish-grey to almost black in colour; the thorax has two faint divergent grey stripes and yellowish hairs, which soon become pale; the antennae are long and black and have dull hairs, but they may be yellowish-brown; the abdomen is dark greyish-black with pale hairs and terminates in a pair of sexual claspers; wings dusky black covered with black pubescence and fringed with black hairs on the hind margin; the halteres are pale yellow, becoming white after death; legs yellowish-brown with dark hairs. The female is much like the male, but is always paler and with a very long extensile ovipositor, which when fully extended is as long as or longer than the body.

The midges hatch out in April about the time the pear blossoms commence to show the first signs of the white petals, and they continue on the wing until the second week in May.

The earliest record I have is the 10th of April, the latest the 17th of May. In the north of England this pest occurs much later than in the south (22).



FIG. 227.
THE PEAR MIDGE
(*Diptosis pyrivora*).
(After Riley.)

If the weather is propitious they commence to lay their eggs as soon as the females have been fertilised.

By means of the long egg-tube the female deposits her ova in the blossoms, mainly on the anthers.

The act of oviposition lasts, it seems, a variable period, for Kollar

(9) says "the female took seven and a half minutes laying her eggs." Some I have observed took over twenty minutes. The number of eggs varies; sometimes as many as thirty may be laid, at others, only ten or twelve. They are laid usually in a group in the blossom, and as several groups may be found it appears that more than one female may attack a blossom, which is evident when we find as many as

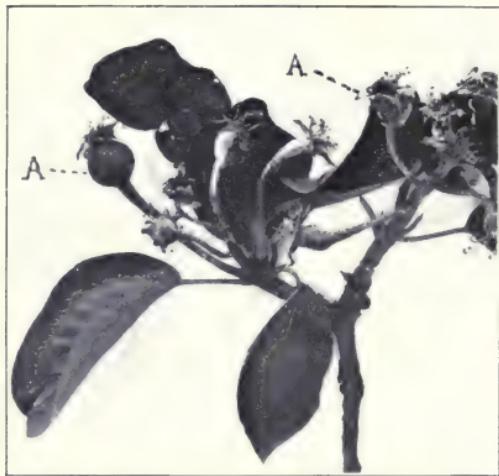


FIG. 228.—ENLARGED FRUITLETS (A) ATTACKED BY MIDGE.
(One-half natural size.)

100 larvae in one fruitlet. The female appears to actually pierce not only the petals but even the calyx with her long ovipositor. Besides laying them in unopened blossoms, I have frequently seen them on the opened blossoms, a fact which I notified Miss Ormerod, and which she recorded (10). The ova are white, longish, pointed at one end and semi-transparent. They hatch in from four to six days. By the end of ten days maggots may be found on careful examination, but they seem to grow very slowly at first. By the first week in June great numbers of the maggots may reach maturity and commence to leave the decaying fruitlets, the majority have left by the second or third week. Some are unable to escape, as the pears do not always crack, unless there has been some rain, and thus remain on the trees longer.

The maggots when mature are about $\frac{1}{4}$ inch long; in colour they



FIG. 229.
LARVA OF PEAR MIDGE.
(Natural size.)

are white to yellowish-white, and are composed of fourteen segments: the head is brownish, and bears two minute, two-jointed, nipple-like antennæ; the "anchor process" is long and brown, broadly expanded at the free end with a median notch.

They leave the fruitlets by a crack which develops in them, as a rule leaping from the side to the ground below, where they still exhibit those curious jumping movements common to this genus of midges. Soon they work their way just under the soil.

At first the young larvæ form small tunnels in the fruitlets, sometimes these are dark, at others they can scarcely be detected with a lens; by degrees as they grow they eat out the pulp, and, as their "frass" cannot escape, the whole of the inside of the pear becomes a blackened mass.

The depth to which they burrow depends upon circumstances. Lintner (11) found them up to $2\frac{1}{2}$ inches, but none below. I have not yet found them below $1\frac{1}{2}$ inch. They then form a delicate cocoon in which they remain and pupate from October on into the winter.

Those which remain enclosed in the fallen pearlets remain as larvæ until they can escape.

NATURAL ENEMIES.

I have been unable to find any natural enemies in this country. Kollar, quoting Schmidberger (9), mentions a parasite *Diplopius nigricornis*, Fabricius, as laying an egg in each larva. There are no records of it, however, in this country. Marchal (23) records *Mostenema pyricola*, Kief., with its quaint larva as attacking this pest.

PREVENTION.

At present we know of no plan which is generally adopted to check the great increase of this pest. In a garden the matter is easy, and even where we have only bush fruit, but where large trees are attacked and over a wide area, nothing much seems of avail.

In garden and on bush trees all infested fruitlets should be hand-picked and burnt before the larvæ escape; if this is persisted in for a year or two over a good area the pest can soon be stamped out, but unless it is done collectively by gardeners and growers the benefit can be but of limited duration, for there is no doubt the insects can fly some distance.

It is even desirable to ruin all one's possible crop for a year to stamp this pest out. This may be done by spraying heavily with an

arsenical wash, and for this Paris green will damage the blossom best. There is thus no food for the maggots, and the result is they die off. If it is done just before the blossom bursts the chance of damaging bees is slight. Nature, fortunately, steps in to help with frosts cutting all the blossom, and thus next year a crop may mature. This has been noticed on several occasions. In America kainit has been shown to destroy in some way the maggots in the soil. An experiment conducted on some badly infested trees in my garden with this gave very positive results, but many growers have written and told me that it has had no effect. I believe Professor Snow found it most successful in America at the rate of a ton to the acre, but the cost and at the same time the damage done to the pear trees makes this impossible here. At Wye (21) I used five hundredweight with desired effect, but perhaps it was not the kainit but some unknown cause that stamped the pest out. Much must depend upon the time of application. It appeared to me to be most effectual when spread on the soil just when the maggots were escaping. At the South Eastern Agricultural College Farm kainit was used *after the larva had gone to earth*, and the attack was not nearly as bad next year (21).

Removal of surface soil, as is done for sawfly attack in gardens, is certainly well worth doing, but, of course, is out of the question in orchard cultivation.

Mr. Bunyard has found that removal of surface soil for about 7 inches and burning it is successful, and also that in an old plantation, by taking off the lower branches and dressing with kainit, the trees were cured to some extent. Lintner (11) suggested drenching the ground beneath the trees with paraffin emulsion soon after the larvæ have fallen. If this is to have any effect it must be done within two weeks after they have fallen, for after that they are protected by their cocoons and, as we found at Wye, thorough drenching then did no good at all (21).

Mr. Page stated, at the conference of fruit-growers at the Royal Horticultural Society in October 1905, that the Pear Midge can be killed by dressing the ground with bone meal, sulphate of iron, kainit, and superphosphate.

One, I believe, of the most practical ways of lessening their damage in orchards is to heavily stock them with poultry at the time the maggots are falling and when the flies are due to make their escape. In every case where this has been done very much good has resulted.

In the case of the large perry pear trees in the western counties

it seems all one can do is to rely on natural checks, and of these frost alone seems to have any effect. It is possible that Mr. Spencer Pickering's idea of spraying the unopened blossom with nicotine wash will prevent egg-laying.

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THE PEAR LEAF-CURLING MIDGE.*(Cecidomyia pyri. Bouché.)*

In a few localities the edges of the leaves of young pear trees may frequently be found rolled up.

This appearance is sometimes natural, but when rolled, owing to the action of this insect, the leaves present an unhealthy appearance.



[F. Edenden.]

FIG. 230.—PEAR LEAVES ROLLED BY MIDGE LARVÆ
(*Cecidomyia pyri*).

On opening the rolls several small whitish maggots of similar form to the pear midge attacking the fruit (*Diplosis pyrivora*) will be found.

Sometimes the roll is only on one side of the leaf, at others on both sides. These larvæ, which are easily told as midge larvæ by the presence of the anchor process or breast bone beneath, leave the galls

when mature and pupate in the soil. The midge appears in the spring as a small dark brown fly, about $\frac{1}{2}$ inch long, with limpid wings and tawny palpi.

It has never been complained of, but as it has been sent for identification it is mentioned as it might possibly greatly increase at some future date.

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SCIARA MIDGES IN PEARS.

(*Sciara.* Spp.)

Very frequently one notices small black flies settled in pear blossoms when expanded, they are larger than the pear midge but are often mistaken for it. If closely examined they can at once be separated by noting the wings which have quite different veins, as shown in the figure (231). These flies belong to what are called Fungus Gnats (*Mycetophilidae*). They appear to go to the blossoms to obtain the nectar and not for egg-laying.

Schmidberger, however, bred from rotten pear fruitlets two species of these flies, and members of the same family were also bred by Inchbald from infested fruitlets sent him by Mr. Bloomfield. These *Sciarinae* have not been identified. Schmidberger called his two, *Sciara pyri* and *S. schmidbergeri*. They evidently only breed in the pears which have decayed through the pear midge attack.



[F. Edenden.

FIG. 231.—BLACK MIDGE. (Greatly enlarged.)

(Mistaken for Pear Midge.)

PEAR APHIDES.(*Aphis pyraria*, Passerini, and *A. pyri*, Fons.)

Two species of aphides occur on the pear in Great Britain, but no complaints of damage caused by them have been received.

Buckton (1) refers to *Aphis pyraria* as occurring for two consecutive years on a tree and giving it the appearance of having been dusted with soot. The tree was nearly stripped of its leaves and wholly gummed over by the aphis secretions. This was at Haslemere in August. Later in the year he received specimens of what appeared to be this aphis from dahlias at Clifton.

The wingless female is sooty-black or bluish-brown, covered by a cottony pile; legs bright yellow, and the young white, with dark honey-tubes and red eyes. The winged female has a yellow abdomen with numerous brown bands and spots; the adult winged form is greenish-black or sooty-brown; antennæ and legs yellow.

The second species, *Aphis pyri*, I have found in Kent on pears, curling up the young leaves and giving them a yellow and red appearance.

Buckton records this aphis from the crab apple at Blackheath, where it rolled and distorted the leaves causing them "to change to yellow or fine red colour."

I have only seen the wingless viviparous female, which varied from olive-green to brown or olive, the abdomen with dark marks, legs dull green to brown; the whole insect is slightly hairy; the pupal stage is pale salmon to pink. The winged female is described by Buckton as being warm sienna-brown, with black abdominal bands and three spots on each side, ginger-yellow legs, black cornicles and antennæ.

I noticed the apterous females at Wye in June, and they soon commenced to curl the leaves beneath which they sheltered. No trace could be seen of them in July.

Spraying with soft soap and quassia or tobacco wash would be sufficient in an attack of this kind.

THE PEAR THrips.(*Thrips physopus*, Linn., and *T. flava*, Schr.)

Carpenter (1 and 2) refers to Thrips on pears in Ireland damaging the blossoms near Dublin.

An allied insect has been fully described by Moulton (3) in America.

A dressing of kainit spread around the trees before the buds open had very satisfactory results (1). Moulton (3) says sprays are not successful as the thrips in the blossoms, etc., cannot be reached, and suggests careful spring cultivation.

The effect of tobacco wash on thrips is very marked and appears to be not only curative but preventive for many days after application.

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THE PEAR LEAF BLISTER MITE.

(*Eriophyes pyri*. Nalepa.)

This gall mite is common in many European countries and has been spread by means of nursery stock to Canada and the United States of America, the Cape and Australia.

The disease affects the pear and apple, and unfortunately has been very much on the increase in recent years in this country.

Ten years ago, although well known (1 and 2), it was not considered very harmful, as it spread so slowly. During the last two years it has taken to spread with great virulence. It has been reported from very many places in Kent and Surrey, and I have also seen it at work in Devon, Worcester and Huntingdonshire. It has only once been sent me on the apple in this country, but in America it is quite common on that fruit.

The disease has become more serious recently because it has attacked the fruitlets as well as the leaves (3). The disease manifests itself as small blister-like patches on the young leaves. At first the little pustules are red, then green or pallid yellow, later, as the leaves get older, they become



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FIG. 232.—PEAR LEAF ATTACKED BY MITE
(*Eriophyes pyri*).

black. These "galls" vary from mere specks up to $\frac{1}{4}$ inch in length. Many often unite, and then the leaves fall off. The effect may be noticed as soon as the leaves begin to unfold, and it is in this early period that much damage is done.

On the fruitlets small reddish pustules appear as soon as the blossom has fallen or even when still out.

Attacked fruitlets were noticed to be entirely destroyed, but sometimes they appear to partially recover and then stunted fruit results.

On cutting a section of the galled leaf the mites, very few in



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FIG. 233.—PEAR FRUITLETS ATTACKED BY THE MITE (*Eriophyes pyri*).

number, will be found in the mesophyll tissues. It has been noticed that when trees have their leaves attacked the fruit is small and gritty (1). I do not know if this is invariably the case, although several correspondents have pointed it out.

All varieties of pears are attacked; notes have been sent me of its presence on over a dozen kinds in harmful numbers.

Nalepa (5) records it from the service berry (*Amelanchier vulgaris*, Mönch), the cotoneaster (*Cotoneaster vulgaris*, Lind.), the white beam tree (*Sorbus aria*, Crautz), the mountain ash (*S. aucuparia*), and the wild service tree (*S. torminalis*, Crautz).

LIFE-HISTORY AND HABITS.

The small mites winter under the bud scales, and as soon as the leaves open they enter them through the stomata. They winter preferably under the second and third layers of bud scales, often in colonies of as many as fifty.

In spring they are seen in numbers first towards the base of the growing bud scale and here they seem to moult. At first they produce a small red pustule, no bigger than a pin point, by the end of a week it may reach the size of a pin's head. Each gall contains but a single female, and she deposits a few eggs, from five to six, as far as observed, and these at an interval of several days.

As the leaves unfold, the mites which breed in the galls crawl out and enter fresh stomata on the same or other leaves, and so the disease spreads. They keep on migrating through June, July and August, and even into September. As the galls grow older they change in colour, eventually getting to black spots of dead tissue.

As the leaves mature off the mites migrate to the forming buds and there they enter between the outer scales. The terminal buds seem to harbour the most. In May and June, if there has been very rapid increase, the mites may be found upon the pubescence of the young wood and on the leaf petioles. In autumn they leave the foliage and may be found moving on the trees and entering the buds. The mite is very like the Big Bud Mite of the currant. In America, the late Professor Lintner found that "under ordinary circumstances it spreads rapidly and proves quite injurious if allowed to continue through the season and for successive years."

Lounsbury (3) considers it a recent importation into the Cape, for only young and newly grafted trees have become infested. The effect of weather on this mite seems important in Canada (2). Mr. Dickson of Guelph Agricultural College has informed me that while artificial means of checking this pest have failed, the extreme severity of the winter in Canada had checked their numbers.

The eggs are found lying in the soft tissue of the leaves; they are oval in form, bluntly rounded at each end, whitish and translucent.

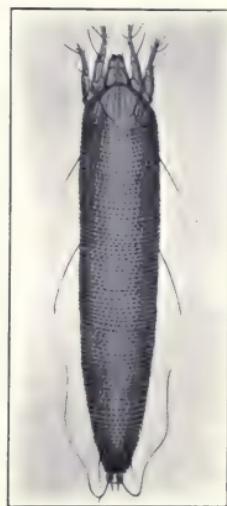


FIG. 234.—*Eriophyes pyri* ♀.
(After Nalepa.)
(Greatly enlarged.)

They take a week to hatch. I have never found them except in the leaves, but Parrott (4) has found them in America at the base of the bud scales and in the pubescence of the buds.

The adult varies in colour from clear white to translucent white, and now and then with a pinkish tinge. The cylindrical body is annulated.

The general characters are seen in the figure (234). The size varies very much, Nalepa giving it as 0·2 mm. in the female, 0·175 in the male.

The larval stage is much like the adult, but the annulation and markings are not so distinct, and it lies in a semi-curved position buried in the substance of the galled tissues.

The earliest record was by Scheuten (6), who called the supposed adult *Typhlodromus pyri*; this was nothing more than a Gamisid mite, probably feeding on the Eriophyes, having no connection with the true gall former, which was first named by Pagenstecher (7) *Phytoptus pyri*.

PREVENTION AND REMEDIES.

There is no doubt that this pest is spread with nursery stock, and it is therefore very essential that such should be fumigated before being planted.

Hydrocyanic acid gas has been found quite effectual for this purpose at the strength used for fumigating young dormant stock (*vide Appendix C*).

In small attacks in gardens the galled leaves should be hand-picked *as soon* as the signs of the disease appear, by so doing in a year or so it will disappear.

Slingerland has found in America that spraying with kerosene emulsion diluted with five to six parts of water exterminates it, and Lounsbury has found the same of benefit at the Cape. This has been tried in Britain, and although it reduced the attack it did not by any means exterminate it.

In 1898, the kerosene emulsion, paraffin-naphthalene wash, and the lime-salt-sulphur washes were tried at Wye, and the latter proved (1) by far the most successful. Since then experiments in America (4) have conclusively proved that a modification of this wash, namely, lime-sulphur-caustic soda, is best for combating this disease, or the boiled lime-sulphur wash.

Paraffin emulsion may be used where apple is attacked, diluted with five parts of water. This is best used in late autumn and early spring. From observations made here, either the lime-salt-sulphur

or the lime-sulphur-caustic soda wash should be applied twice, in late November and in February on pears.

It seems (4) much more difficult to control in America on apple than pear, particularly on account of the pubescence of the buds.

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- (7) *Pagenstecher, H. A.* 'Verhandl. Naturhist. Med. Ver. Heidelberg,' vol. I., p. 48 (1857).

PLUMS.

LIST OF INSECTS, ETC., INJURIOUS TO PLUMS.

LEPIDOTERA.

- WINTER MOTH (*Cheimatobia brumata*. Linn.). Foliage, p. 50.
 MOTTLED UMBER (*Hybernia defoliaria*. Clerck.). Foliage, p. 58.
 EARLY MOTH (*Hybernia rupicapraria*. Hb.). Foliage, p. 362.
 MARCH MOTH (*Anisopteryx aescularia*. Schiff.). Foliage, p. 61.
 FIGURE-OF-8 MOTH (*Diloba cæruleocephala*. Linn.). Foliage, p. 35.
 GOAT MOTH (*Cossus ligniperda*. Fab.). Wood, p. 42.
 WOOD LEOPARD (*Zeuzera pyrina*. Linn.). Wood, p. 46.
 VAPOURER MOTH (*Orygia antiqua*. Linn.). Foliage, p. 38.
 PLUM FRUIT MOTH (*Opadia funebrana*. Tr.). Fruit, p. 363.
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COLEOPTERA.

- BARK BEETLE (*Scolytus rugulosus*. Ratz.). Bark, p. 111.
 SHOT BORER BEETLE (*Xyleborus dispar*. Fab.). Wood, p. 367.
 FLAT-CELLED SHOT BORER (*X. xylographus*. Ratz.). Wood, p. 370.
 RED-LEGGED PLUM WEEVIL (*Otiorhynchus tenebricosus*. Herbst.).
 Foliage, Shoots and Buds, p. 428.
 CLAY COLOURED WEEVIL (*Otiorhynchus picipes*. Fab.). Foliage and
 Shoots, p. 425.
 GREEN LEAF WEEVIL (*Phyllobius maculicornis*. Germ.). Foliage,
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- PLUM LEAF SAWFLY (*Cladius padi*. Linn.). Foliage, p. 372.
 PLUM FRUIT SAWFLY (*Hoplocampa fulvicornis*. Klug). Fruit, p. 376.
 SLUGWORM (*Eriocampa limacina*. Cameron). Foliage, p. 334.
 SOCIAL PEAR SAWFLY (*Pamphilus flaviventris*. Cameron). Foliage,
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HEMIPTERA.

- LEAF-CURLING PLUM APHIS (*Aphis pruni*. Réau.). Foliage, p. 379.
 MEALY PLUM APHIS (*Hyalopterus pruni*. Fab.). Foliage, p. 383.
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 Foliage, p. 247.

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THE OYSTER-SHELL BARK LOUSE (*Aspidiotus ostreiformis*). Bark, p. 386.

THE MUSSEL SCALE (*Lepidosaphes ulmi*. Linn.). Bark, p. 165.

THE BROWN SCALE (*Lecanium capreae*. Linn.). Bark, p. 175.

THE FRUIT LEAF HOPPERS (*Chlorita viridula*, Fall., and *C. flavesceens*, Fab.). Foliage, p. 392.

THE OAK LEAF HOPPER (*Typhlocyba quercus*. Fab.). Foliage, p. 391.

ACARINA.

THE PLUM LEAF GALL MITES (*Phytoptus phloeoptes*, Nal., and *P. padi*, Nal.). Foliage, p. 398.

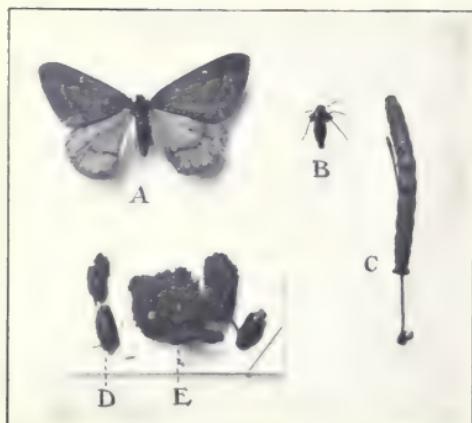
THE RED SPIDER (*Tetranychus telarius*. Linn.). Foliage, p. 397.

BEETLE MITES (*Oribatidae*), p. 401.

THE EARLY MOTH.

(*Hybernia rupicapraria*. Hb.)

Now and again the looper caterpillars of this geometer are found in some numbers on plums, damsons and bullaces. Its normal food plants are hawthorn and blackthorn.



[F. Edenden.

FIG. 235.—THE EARLY MOTH (*Hybernia rupicapraria*).

A, male ; B, female ; C, larva ; D, pupae ; E, cocoons.

stumps of wings are greyish, with a dark line on the front pair, and a very slender streak across the hind pair.

The caterpillar is green to bluish-green, with a pale green back, the front of each segment darkened and a white line on each side.

When mature they fall from the leaves and pupate in the soil.

The moth occurs in January and February. The male has grey-brown fore wings with a broad dark area across the middle, the edges dark and notched, with a dark spot in the middle; the hind wings are whitish-grey, with a dark central spot above the middle and crossed by an indistinct grey streak; the wing expanse about $1\frac{1}{4}$ inch. The female is almost wingless, the

The moth is widely spread over Britain. I know of no records of it having caused serious damage.

Should it occur in sufficient numbers it can easily be prevented by "grease-banding," as for Winter Moth, and arsenical spraying.

THE RED PLUM MAGGOT.

(*Opadia funebrana*. Tr.)

This is a well-known insect, entomologically, but fruit-growers seem to pay little attention to it. Stainton says: "In the caterpillar state it is exceedingly plentiful in plum pies."

One does not like finding these little caterpillars, as frequently happens in the West of England, in plum and damson tarts, and their presence in bottled fruits, as was reported from the Horticultural College, Swanley (1), is just as bad, and would materially lessen the market value.

In 1894 it occurred in some numbers in plums at Kingston-on-Thames (2), many larvae being obtained on the 15th of August. The plums fell before they were quite ripe, one tree lost all the crop. On examining the fruit, a hole at the base of the plum near the stalk is noticeable, and on opening the fruit,

the centre is seen to be damaged, and there is much wet "frass," together with the reddish caterpillar. They live inside the plum around the stone, tunnelling here and there into the flesh.

The damage done by the maggots to the fresh fruit is not so easy to detect, especially in damsons.

Very frequently, in fact, in the majority of cases, the fruit does not fall, and hence the larvae get bottled with the fruit and get into pies, etc.



[F. Edenden.

FIG. 236.—PLUM OPENED TO SHOW WORKING OF PLUM MAGGOT.



(*Horace Knight.*

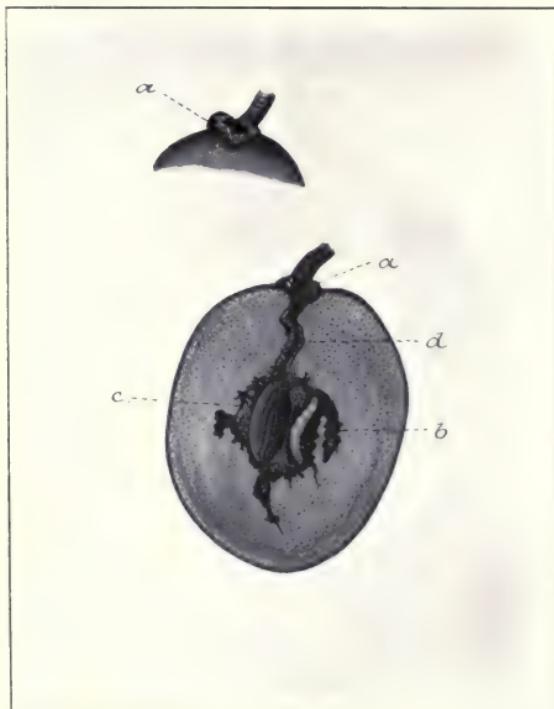
FIG. 237.—PLUM FRUIT MOTH
(*Opadia funebrana*).

Specimens were received in 1894 from Headley, the maggots being found in their cocoons under the "shreds" used for nailing wall trees. It has also been reported as being very troublesome in some years in the Isle of Thanet.

Besides feeding on cultivated plums and damsons, it also feeds on the sloe and other wild prunes.

LIFE-HISTORY AND HABITS.

The moth appears in June and July. The female places her egg



[F. V. Theobald.]

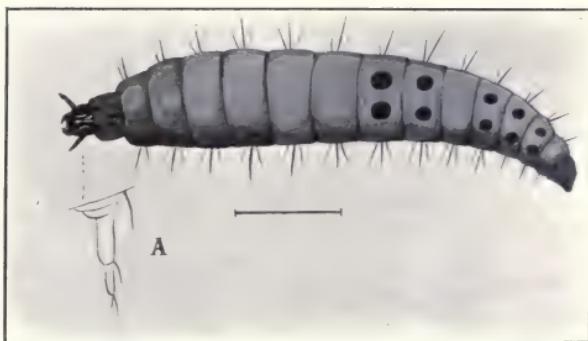
FIG. 238.—PLUM ATTACKED BY THE RED MAGGOT OF *Opodia funebrana*.
a, entrance hole of larva; b, larva; c, cavity eaten out around stone; d, gallery to stone.

at the base of the stalk, and in ten days the small caterpillar hatches, and at once enters the fruitlet.

The moth is about $\frac{1}{2}$ inch in wing expanse. The fore wings are purplish-grey, clouded with smoky-grey; at the anal angle is an indistinct ocellated patch, edged with shiny pale grey and enclosing four black dots. Stainton (3) describes the fore wings as grey, clouded

with smoky-grey. Mr. Farren, F.E.S., of Cambridge, told me that Stainton's description was probably drawn up from a faded specimen, and that his specimens were more purplish-grey, and this is certainly the case; some are much darker than others.

The larvae observed at Kingston were all full grown the first week in September, but many matured in the end of August. The caterpillar is chestnut-red, the sides yellowish; others are deep red all over. The head is dark brown and shiny; the first segment yellowish-brown; segments eight, nine, eleven and thirteen have each two lateral spots of a dark hue, and the twelfth has a dark mark in the centre of the dorsum. There are three hairs on the side of each segment, except the last, which has many. Each segment is much wrinkled. The true legs are pale brown; the prolegs pale pinkish.



[F. V. Theobald.]

FIG. 239.—LARVA OF THE PLUM FRUIT MOTH (*Opadia funebrana*).

A, further enlarged antenna.

The antennæ are of four segments, a bristle arises from the basal one, and another from the base of the fourth, and there are two small ones terminally. When full grown the larvae measure about $\frac{5}{8}$ inch.

The larvae, when they leave the fruit, seek shelter under rough bark, debris on the ground, or as was recorded from Headley, under the shreds used for nailing wall trees.

In such-like places they spin cocoons of whitish silk, and remain as larvae all the winter, giving rise to amber-coloured pupæ, which are dark brown towards the posterior extremity. Kollar (4) also refers to them as pupating under the bark.

PREVENTION.

Little or nothing has been done to deal with this pest, yet it is one the plum grower has now and then to contend with. At present

we know little of its workings. As far as we can see, trapping seems the most successful method of prevention. This may be done as for the Codling Moth, as from what we see recorded from Headley, the maggots pupate under "shreds" and other cover, and would be doubtless caught in "sack bands."

Kollar (4) p. 233 refers to the plums ripening prematurely, and says: "We should shake the tree to make that plum fall and immediately convey it out of the garden." On a small scale we can do this, but it must be done often and thoroughly.

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- (3) *Stainton, H. T.* 'A Manual of British Butterflies and Moths,' vol. II., p. 253 (1859).
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PLUM TORTRIX.

(*Penthina pruniana*. Hb.)

This is the most abundant Tortrix I have found on plums, and it frequently does as much harm as the Winter Moth.

The moth has the front wings with blackish-brown bases, then follow pale areas and a white spot on the outer edge on the fold, the apex white, clouded with grey posteriorly, hind margin dark grey, and three or four dark grey spots near the middle of the central band.

Hind wings brownish-grey. Wing expanse about $\frac{3}{4}$ inch. It appears in June and July and readily

flies from the trees when they are shaken.

The caterpillar feeds also on apple, cherry and nut, and on the sloe and bullace; it is found in May and pupates as the other species referred to on p. 78.



(*Horace Knight.*
FIG. 240.—*Penthina pruniana.*)

TREATMENT.

Spraying, as for the Apple Tortrices, only directly after the plum blossom has fallen.

THE SHOT BORER BEETLE.

(*Xyleborus dispar*. Fab.)

The beetle dealt with here now and again occurs in such numbers that serious loss is occasioned.

Its popular name, Shot Borer Beetle, is derived from the curious



[F. Edenden.

FIG. 241.—SHOT HOLE BORER (*Xyleborus dispar*).

Showing long gallery A.

shot-hole like opening it makes in the affected trees, and the habit of many remaining in one tunnel when hatched, completely filling it up like a line of shot. The working is very different from the Bark Beetle (p. 111). This beetle drives long tunnels into the heart of the wood. In young trees they partially ring them, and the result is death of the upper parts; in older trees the long tunnels they drive into the substance of the trunks and boughs interfere with the normal flow of the sap. When attacking small growths they may tunnel right up to the central portions.

It is by no means confined to fruit trees, for beech, maple,

chestnut, oak, alder, elm, and hawthorn are attacked by it, and it has also been recorded from conifers. Amongst fruit trees it occurs on plum, apple, pear and cherry. It is said by Ormerod (1), who quotes from Kollar (2), and others that it was one of our rarest insects until 1899. In 1884 I found it doing much harm to plum trees at Kingston-on-Thames, and again in 1887 and 1888 at Cambridge. It has probably always occurred here and there in numbers.

The best detailed account of it is given by Kollar (2), some of which reappears in Miss Ormerod's Handbook (1).

The districts from which it has been recorded are Gloucestershire, Worcestershire, Surrey and Cambridgeshire.

LIFE-HISTORY AND HABITS.

The beetle is pitchy-brown to black in colour, the wing cases being reddish-brown, more so in the male than in the female; the antennae are clavate and reddish, the thorax granulated, the elytra with alternate rows of punctures and fine, pubescent interspaces; legs reddish-brown.



[F. Edenden.]

FIG. 242.—SHOT HOLE BORER (*Xyleborus dispar*).
Showing three galleries.

The female commences her attack by boring into the main stem for preference. She then makes passages, and in a small chamber at the opening of each of these she places her eggs, white in colour and longish in shape. Kollar says: "At the end of the entrance, the female makes a somewhat wide apartment and lays her eggs in it in a heap, from seven to ten in number and sometimes fewer."

As they hatch, some time in May and June, the larvae proceed along the tunnels one after another so as to partly fill them, and there they feed and pupate.

The female is $\frac{1}{8}$ inch long, the male is much smaller than the female; the female has a large hump-backed thorax, the head hidden beneath it, and the wing cases of the male are much more curved.

The males are very rare in the summer, but commoner in the winter.

When ready to hatch the pupæ are packed fairly close together, and this accounts for the presence of so many beetles packed like shot in the tunnels.

The maggots feed on a grey and black layer lining these tunnels, a substance called by Schmidberger and others "Ambrosia." This lining has been described by Eichhoff as formed from the sap which soaks out of the walls of the tunnels and which thickens into a white egg-like coagulation, and on this a coating of fungus develops; after a time the surface of the circular galleries becomes black. He tells us that these coagulations and fungoid growths serve solely as the food of the Shot Borer Maggots. As many as thirty or forty ova are laid by each female. These are laid at different times on till June. Thus we find maggots of various sizes close together and all derived from the same parent.



[F. E.]

FIG. 243.—FLIGHT HOLE (A) OF SHOT BORER BEETLE (*Xyleborus dispar*).

[Horace Knight.

FIG. 244.—SHOT BORER BEETLE
(*Xyleborus dispar*).

January, February, May, September, on to December. The larvae appear to grow rapidly, and by mid June beetles appear. During the year 1908 some hatched in November.

When first hatched they are soft and reddish, and they

remain in their galleries for several weeks before they make their exit.

Schmidberger describes how the parent remains in the tunnel until all her offspring are mature.

There appear to be two generations, the second egg-laying taking place in August and September.

PREVENTION.

All attacked trees should be cut and burnt in winter. Trees nearby should be treated so as to prevent attack. This may be done by thickly smearing the trunks with some non-noxious substance, such as clay and lime or, if there is no stock, a mixture of clay and arsenate of lead.

In America soft soap reduced to a thick paint by the addition of a strong solution of washing soda is applied to the bark (3) (Saunders' wash), but we find there is often damage done by this, and the former is therefore to be advised. Soft soap and carbolic acid is also recommended (*vide Scolytus rugulosus*, p. 111).

Using attacked trees as "trap" trees and destroying them is the most important step we can take to keep down this beetle.

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- (3) *Fletcher, J.* Report of the Entomologist, Department of Agriculture, Canada, p. 28 (1887).
- (4) *Hubbard, H. G.* Ambrosia Beetles of the United States. Some Miscellaneous Results of the Work of the Division of Entomology, U.S. Dept. Agri., p. 24 (1887).
- (5) *Eichhoff, W.* 'Die Europäischen Borken Käfer, Kaiserl.-Oberförster in Mulhausen, Elsass.' Berlin (1881).

THE FLAT-CELLED SHOT BORER.

(*Xyleborus xylographus*, Say, or *Xyleborus sureseni*, Ratz.)

This beetle works in a very similar way to the preceding, but the brood chambers are *broad and flat* instead of being cylindrical as in the former species.

It is a widespread insect, occurring over most of Europe, the Canary Islands, North America and Japan. It feeds on a great variety of plants, including apple, pear, plum, oak, beech, birch, lime,

maple, poplar, and various conifers. The only record I know of it causing any harm in fruit is one given by Ormerod (1), who mentions it from Toddington, Gloucestershire, in 1889.

LIFE-HISTORY AND HABITS.

The female is rather more than $\frac{1}{2}$ inch in length, the male somewhat smaller, but broader. In colour they are almost black, with some grey hairs; the males are wingless and paler, almost brown. It differs from *X. dispar* in not having the thorax raised in the middle into a hump. The beetles (female) pass the winter in the brood chambers and emerge in the spring. They then enter trees by the edge of a wound, or at a dead part of a tree and excavate their brood chamber. This chamber is enlarged by the larvae, which are white, and very similar to those of the former species, and about $\frac{1}{2}$ inch long; here they mature and pupate. This chamber is formed at the end of a gallery, which may penetrate into the heart of the tree or remain in the sapwood, according to Hubbard (2).

The larvae are described as passing out the wood pulp as a mustard-coloured mass, and great quantities are ejected from the opening of the colony, but some remains and is plastered on the walls of the chamber to serve as soil for a new crop of the "Ambrosia" fungus used for food by the maggots.

The larvae are found in England in July, when some appear to pupate. These larvae and pupae are tightly packed in the chambers, which may reach nearly 1 inch in length, and according to Ormerod (1) are covered for the most part with a very thin coating of a wax-like material, greyish in colour and with a somewhat sweet scent, "and the surface of the wood of the chamber, wherever it was visible, was certainly not of the black colour so noticeable in connection with the workings of *X. dispar*. It was rather of a brown colour and moist-looking appearance."

I have never seen this attack, which appears to be uncommon in this country.

Ormerod (1) mentions that numbers of Beetle Mites (*Oribatula lapidaria*) were found on the infested trees, and suggests that they might be feeding on the "Ambrosia" fungus.

PREVENTION.

Very similar steps may be taken as for *X. dispar* to keep this pest down. One point we may bear in mind and that is, that the beetles

appear to enter at any wound, and thus it would be well to clean all wounds and fill in with wax or Stockholm tar.

A full account of this insect will be found in Hubbard's report (2).

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THE PLUM LEAF SAWFLY.

(Cladius padi. Linnaeus.)

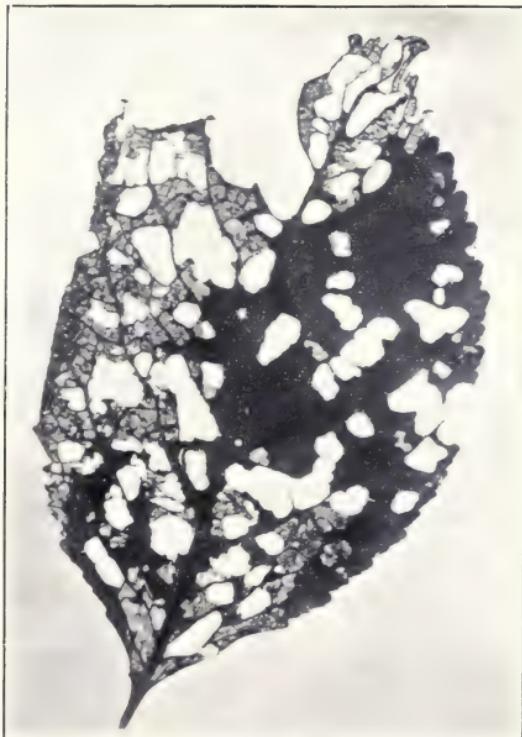
There exist two species of sawflies which attack the plum in this country. One may frequently be seen, namely, the Plum Leaf Sawfly, the *Tenthredo padi* of Linnaeus, now known as *Cladius padi*. The second is the *Hoplocampa fulvicornis*, Klug, which in the larval stage feeds inside the young plums and speedily causes them to fall (*vide* p. 376). The leaf-eating species does considerable damage when very abundant, but, fortunately, although widely distributed over the British Islands (1), it does not often occur in sufficient numbers to do any appreciable amount of harm. During 1906 two attacks were reported where the plum trees had every leaf spoiled by the larvæ. It occurs even at considerable elevations, Cameron (1) having taken it at 2,300 feet in the Scotch mountains. It is found over most of Europe, where it is now and again recorded as being of an injurious nature.

There do not seem to be any published records of its causing damage in Britain except the record in the S. E. College Journal (2).

The food plants, besides plum, are pear, rose, hawthorn, bramble, mountain ash and birch. It occurs on both wild and cultivated roses, and I have found it on wild prunes, such as bullace and sloe. Mr. C. O. Waterhouse has bred it from cherry at Acton, where he noticed it doing much damage.

The damage is done entirely by the larvæ eating the leaves. In the early stages of the attack the leaves resemble those infested with the Slugworm (*Eriocampa limacina*), but the upper, not under epidermis, remains intact; the young larvæ eat the lower epidermis and soft mesophyll tissues and leave the upper epidermis. It differs

from the slugworm attack, also, in that the damaged areas are smaller and usually somewhat rounded in form. They become brown, giving the leaves a spotted appearance which in the distance might be taken to be some fungus work. As the larvæ grow they become more ravenous and eat out large holes in the leaves which shrivel up, and the tree presents a scorched appearance (Figs. 245 and 246).



[F. Edenden.]

FIG. 245.—PLUM LEAF DAMAGED BY LARVÆ OF THE
PLUM LEAF SAWFLY.

LIFE-HISTORY AND HABITS.

The parent of these leaf-destroyers appears in May, sometimes early in the month, at others even as late as June. The female is black; the thorax shiny with scattered greyish down, and two dull white spots. The abdomen is mainly black, with scattered pale, very fine hairs. Legs white, except for the middle of the femora, apex of tibæ and posterior tarsi which are black, but much variation exists, sometimes the femora are all white, at others all

black, sometimes with just a speck of black in the middle. There may also be variation in the other parts of the legs. The wings are slightly smoky with pale costa. In the male the antennæ are shorter than the body, but in the female they are nearly as long.

There is apparently much general variation, for Cameron (1) says, "in many specimens the colour is testaceous and may have a yellowish tinge."

The females appear to lay their eggs during the warmest part of the day. The eggs are placed anywhere on the under surface of the leaves, just as is done by the slugworm. They hatch out in

about eight days; a few under observation incubated in five days. The young larvæ at once commence to feed on the under epidermis, eating their way out at the surface. At first the larvæ are pale greyish-green with a reddish tinge, sometimes varying to grey, the sides pale green to white, and the last two segments are pale. When older they are green or greyish-green with almost white sides and last two apical seg-



FIG. 246.—*c*, PLUM LEAF EATEN BY PLUM LEAF SAWFLY (*Cladius padi*); *a* and *b*, LARVÆ.

ments; the head is variable, but usually pale, dull, orange-brown, with spots of a lighter orange hue and a very prominent black mark at the back of the head extending forwards. Now and again in mature larvæ the head is either all deep orange or all dusky black, and even the black mark may be absent. The larvæ, when not feeding, remain in a coiled position under the leaves.

Larval life lasts about three weeks. When mature the larvæ fall to the ground and burrow into the earth. An oval cocoon of parchment-like material is formed in which it changes to a pale grey pupa. This quiescent stage lasts from nine to twelve days. The whole life-cycle may thus be completed in five weeks.

The second brood appears about the middle of June, and these

deposit fresh eggs which give rise to larvae, and from these a third brood may and frequently does appear in September and October.



(Horace Knight.

FIG. 247.—PLUM LEAF SAWFLY (*Cladius padi*).

The last brood are frequently, like the slugworm of the pear, the most noticeable. This autumn brood of larvae fall to the ground and remain in their silken cases until the following April or May in the larval condition, when they then pupate.

NATURAL ENEMIES.

Two parasites were reared from this sawfly by Cameron, namely, *Ichneutes reunitor*, Nees, and *Tryphon lucidulus*, Nees, both of which attack the larvae.

PREVENTION AND REMEDIES.

The ground beneath trees, which have been infested, should be well prong-hoed in the spring and well trodden down afterwards. It would be better to remove a couple of inches of surface soil during the winter, burn it and replace it later where a tree here and there has been attacked, which, needless to say, could not be done on a large scale.



[F. Edenden.

FIG. 248.—LARVÆ OF *Cladius padi* AT WORK.

The larvae fall readily to the ground if the tree is jarred, especially when they are rolled up and not feeding. This enables us to cope with this pest mechanically, by jarring them off on to tarred sacks or any other convenient way in which they may be collected.

Arsenate of lead may be used as a spray or the more conventional hellebore wash. Fortunately, feeding on the under surface of the leaves, they are more readily poisoned than the slugworm, as the poison is not so easily washed off by rain.

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THE PLUM FRUIT SAWFLY.

(*Hoplocampa fulvicornis*. Klug.)

The plum has long been observed by growers and gardeners to be attacked by a large maggot, which we now know to be the *Hoplocampa fulvicornis* of Klug, the *Tenthredo morio* of Schmidberger and Kollar (4).

During the last ten years the ravages of this sawfly have certainly become more marked than formerly.

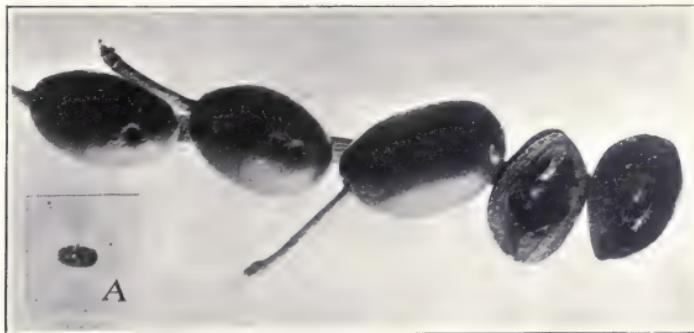
Frequent complaints have been sent me from Worcestershire, where in the Evesham district in 1906 considerable damage was done to several varieties, including greengages.

From Ross Mr. Getting wrote first in May 1905, complaining of the damage, and sending small plums many of which showed the round exit hole of the larva (Fig. 249).

In June towards the end of the month he found many pierced fruitlets on the ground, but all the grubs had left them (1). In June 1907 he wrote again complaining of a still further attack and on more trees. In 1889 a Victoria plum at Boughton was examined, in which every fruitlet had been struck; since that year the Plum Sawfly has not occurred in the locality. In 1907 a prune on the South Eastern Agricultural College plantation was badly infested, no trace of it had been seen before anywhere near.

Ormerod (2) records it from Urchester in June, the observer mentioning that the plums were heavily attacked, quite half the crop being injured, also from the Toddington Fruit Plantations, and also from the same locality in which complaints were made to me (3)

in the Evesham district. The damage is done to the young plums by the larva of this sawfly eating out the interior. If the fallen fruitlets are cut open a pale larva, at once seen to be that of a sawfly, is detected within it. Later the infestation manifests itself more clearly by the presence of a round hole in each fruitlet whence the sawfly larva has escaped. The developing kernel seems to be their chief attraction, for in all I have examined this has been either damaged or completely destroyed. Fruitlets from $\frac{1}{2}$ to nearly 1 inch in length have been found damaged. Ormerod says that those she examined from Urchester had usually one boring near the end opposite to the insertion of the stem. In all those



[A. V. D. Rintoul.]

FIG. 249.—PLUM FRUITLETS DAMAGED BY SAWFLY (*Hoplocampa fulvicornis*).
A, cocoon from soil.

sent me from Herefordshire and those found at Wye the exit hole was at the side.

The opening is usually filled with wet frass as long as the larva is within, similar to what we notice with the Codling Moth.

I have never yet found more than one larva in each fruitlet. Although greengages have been especially mentioned as being attacked, it appears that all varieties of plums suffer, for I have seen it in Czars, Early Prolifics, Victorias, Blue Gage, Damson Plum and Pershore.

Kollar (4) says "the greengage and other round plums are attacked when they are hardly the size of a pea."

LIFE-HISTORY.

The sawfly appears in April and May. In colour it is shiny black with yellow, yellowish-red or reddish-brown legs and iridescent wings and with wing expanse of rather more than $\frac{1}{3}$ inch.

The female places a single egg in each unopened blossom, puncturing the blossom, according to Kollar (4), in the notched part of the calyx, making an oblique opening, and immediately introduces its egg into the deepest part. The egg is very minute, greenish-white and transparent. It hatches in a few days (variously estimated from a week to a fortnight), and then the young larva forces its way into the embryo fruit and feeds on the developing kernel.

When one fruit is damaged it eats its way into another. I found that the larvae sent me from Ross, some of which were nearly half grown, attacked two plums before they were mature.

The larva is creamy-white, in some cases having a faint pinkish tinge, the tail end is somewhat attenuated and the position usually slightly curved, the head brown, the six jointed - legs are pale brown and there are six pairs of pale prolegs and an anal pair. When full grown the length is about $\frac{1}{3}$ inch when expanded.

The inside of the quite small plums are completely hollowed out, but in the larger fruitlets a space is merely shown around the kernel which the larva has devoured. This cavity is sometimes filled with moisture and decayed matter, but when the larvae are within, is usually quite clean. No smell could be detected in any sent me, such as is described by Ormerod (2), possibly the specimens she received had lain together some time in the box, for it was noticed that where this was allowed the fruitlets became a wet putrid mass in a few days.

On reaching maturity the larvae leave the fruit and enter the soil. Those received in 1907 pupated from the 17th to the 26th of July, but in 1905 some had entered the soil by the 5th of the same month. In a few days I found they had spun small, roundish oval, brownish cocoons, of the size shown in the photograph (Fig. 249), fairly close to the surface ; they were spun up in the sand and very difficult to detect owing to the sand sticking to them, but the parchment-like cocoons were brownish in colour. The larvae remain in these cases



[Horace Knight.

FIG. 250.—THE PLUM FRUIT SAWFLY (*Hoplocampa fulvicornis*).

all the winter and pupate in February. A single brood only occurs. The sawflies, like those which attack the apple, are only seen on the wing in bright still weather.

PREVENTION AND TREATMENT.

There seems to be no way of preventing the insects from laying their eggs. It is advisable when a single tree is affected in a garden or plantation to have the whole of the fruitlets picked and burned, so as to stamp the insect out; if this is not done it may spread to the surrounding trees another year. All infested fruitlets should be picked up and destroyed at once. Land beneath trees which have been attacked might be dug over, well prong-hoed and heavily dressed with gas lime in winter. No trials have been made, but it is quite possible that a long sticking arsenical wash, such as Swift's Arsenate of Lead Paste, sprayed over the young fruit would poison many of the larvæ as they bore into fresh fruitlets; it is certainly worth a trial where this insect is very harmful.

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- (2) *Ormerod, E. A.* 'Handbook of Insects Injurious to Orchard and Bush Fruits,' p. 182 (1898).
- (3) *Theobald, F. V.* Report on the Orchards and Fruit Plantations of Worcestershire, p. 14 (1906).
- (4) *Kollar, V.* 'A Treatise on Insects' (Eng. Trans.), p. 268 (1837).
- (5) *Taschenberg, E. L.* 'Praktische Insekten-kunde,' II., p. 324 (1879).

THE LEAF-CURLING PLUM APHIS.

(*Aphis pruni*. Réaumur.)

The Plum Aphid (*Aphis pruni*, Réaumur) is one of the most destructive plum pests, and has been unusually severe in its attack in recent years. Complaints have come to hand from all parts of the country regarding the harm done by this aphid. Its attack is very characteristic, the edges of the leaves gradually rolling around and forming nests for the rapidly increasing insects; in bad attacks the curled leaves die, and then the fruitlets soon commence to fall. Sometimes the young leaves that are attacked fall prematurely when still green, but, as a rule, they hang on until dead and the tree presents a strikingly characteristic appearance.

Damson plantations often suffer most severely from this blight. A good show of blossom may be seen, and by June scarcely a fruitlet or leaf will be on the trees. Plums of all kinds and greengages suffer nearly as severely. The same species may be seen on peach, apricot, apple and, according to Buckton (1), on the aster. It is subject to considerable variation in size and colour and probably occurs on other plants, amongst which have been mentioned chrysanthemums and gooseberry. Wild prunes afford a constant means of invasion of our plantations. This species must not be confused with the Hop-Damson Aphid (*Phorodon humuli* var. *malaheb*), easily told by the frontal tubercles, which are absent in this species. Numerous complaints have been received from the Whimple area in Devonshire (3),



[A. V. D. Rintoul.]

FIG. 251.—PLUM LEAVES CURLED BY *Aphis pruni*.

as well as Worcestershire, Kent, Middlesex, Surrey, Hampshire, Hertfordshire and Essex.

LIFE-HISTORY AND HABITS.

This aphid first makes its appearance in the very early spring, when we observe small, dark green lice here and there on the shoots. These have come from eggs that have remained all the winter upon the plum trees. These lice grow into the wingless viviparous females, large aphides, varying in hue from dull purple to olive-brown.

These apterous females soon commence to produce living young, which rapidly mature and produce other young. The young pro-

duced by the dull purple "mother-queen" are green, and when they became mature viviparous wingless females they vary from olive-brown to green, the abdomen has three faint green stripes, antennae olive-brown and cornicles brown. This asexual reproduction of wingless forms goes on for some time and, under favourable conditions, to such an extent that the leaves which have gradually curled up die off. As food supply commences to fail, these lice, instead of turning to wingless viviparous females, enter a pupal stage, rudiments of wings, "wing buds," appearing.

The pupa is shining green and dull yellowish, the wing cases tipped with dark brown; green cornicles also tipped with black. I have observed the pupal form in the first week in June, and again in July. Sometimes all on a tree enter this stage at once, at others only a few.

The winged female coming from the pupa is also viviparous; in colour she is apple-green, with black head, thorax and antennae; on the green abdomen is a dark patch and dark lateral spots; the wings are iridescent with brown veins.

These winged viviparous females fly away. What happens after their leaving the prunes in June we do not know, but they certainly do so and return again in the autumn as winged females which produce young which eventually give origin to males and females.

The winged male is small, and with a dusky ochreous body, with dark brown head, markings on the thorax, and three on the abdomen. The colour varies considerably, some males being almost black, some wholly black, according to Buckton.

The oviparous female is apterous and pale yellowish-green, almost transparent, with brown cornicles. This female, after being fertilised

A. YOUNG *Aphis pruni*.B. YOUNG *Aphis prunifolia*.
(Greatly enlarged.)FIG. 253.—LATER STAGE OF *A. pruni*
(viviparous female).
(Greatly enlarged.)

by the male, deposits little shiny black eggs at the base of the buds and on the twigs. Egg-laying may commence early in October and goes on till November. These eggs usually hatch early in April, but I have observed the lice in March.



FIG. 254.—*Aphis pruni*.

Second generation (viviparous female).

difficult to destroy the pest, for not only are they protected by the curled leaf, but also by the honeydew and meal which help to repel the insecticide.

Washing should start before the blossom buds open, so as to destroy the mother-queen before she produces her green young. In any case it should never be later than the date of falling of the blossom; up to this time some good will be done. The object should be, however, to kill the mother-queens before the blossom appears.

Considerable benefit has been found from lime wash, salt and waterglass heavily sprayed over the plums and damsons just before the buds burst. The eggs are laid in crevices, bud groups, etc., where the lime wash collects, and very many are thus prevented from hatching. The writer has seen trees completely clear of the *Aphis pruni* and the *Phorodon humuli* (Hop-Damson Aphid) by this treatment, and it cannot be too strongly

Besides prunes this *aphis* is also found on peach, nectarine and apple, but I have not seen it breeding on those plants.

I am inclined to believe it flies to umbelliferous plants (3) and breeds there. An allied species, *A. prunifolia*, is shown (Fig. 252 b).

PREVENTION AND TREATMENT.

This pest can easily be kept in hand if attacked in its early stages, but when once the females have set to work to produce those countless living young and they curl up the leaves it is most



(F. Edenden.

FIG. 255.—MOTHER-QUEEN OF PLUM
APHIS IN AXIL OF BUD.

(Much enlarged.)

advised as a late winter wash where aphis is prevalent. Mr. Howard Chapman, of Western Cross Farm, Greenhithe, was the first to point out the great use of this wash as a means of checking the Leaf-curling Plum Dolphin.

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- (1) *Buckton, G. B.* 'A Monograph of British Aphides,' vol. II., p. 64 (1877).
- (2) *Theobald, F. V.* Second Report on Economic Zoology (Brit. Mus. N.H.), p. 148 (1904).
- (3) *Theobald, F. V.* Report on Economic Zoology for the year ending April 1st, 1907, p. 74 (1907).
- (4) *Whitehead, Sir C.* 'Insects Injurious to Fruit Crops,' p. 88 (1886).
- (5) *Ormerod, E. A.* 'Handbook of Insects Injurious to Orchard and Bush Fruits,' p. 146 (1898).

THE MEALY PLUM APHIS.

(*Hyalopterus pruni*. Fab.)

The Mealy Plum Aphid is never very obnoxious in Kent, but in Worcestershire it is very abundant. It also causes some annoyance in Herefordshire, and is recorded once from north Devon.

I have frequently seen it in Surrey and Middlesex, especially in the neighbourhood of London. Carpenter (4) records it from Navan, Ireland.

This aphid is quite distinct from the previous species and does not seem to do so much harm directly to the trees, for leaves keep green and sound when laden with these insects for some time. The great quantity of honeydew they secrete falls on to the leaves below, and on to the fruit, and thus its obnoxious nature manifests itself. I have seen good crops of plums spoiled by it.

LIFE-HISTORY.

The Mealy Aphid appears in June and July, usually the latter part of July, but in 1906 they made their appearance early in the month. In 1905 they appeared early in June at Wye, and Mr. Getting recorded them in large numbers at the end of June in the same year at Ross. They continue increasing under the leaves until the end of August, and into September. During 1907 I received a communication concerning the ravages of this aphid from Scotland, and on the 20th of November numbers were sent on late plum leaves.

They are easily told by their pale green colour, and the dense mealy secretion they become covered with. The honeydew falling

from them becomes a black, sticky mass, and this damages the leaves below them as well as the fruit.

In colour this aphis is pale green with deeper green mottlings, and a dark median stripe, and is covered with white meal. They cluster close together under the leaves until a whole leaf is smothered by them. Then winged viviparous females are produced of a bright yellowish-green with dark green markings on the thorax, and triangular ones on the abdomen, and with red eyes. They are covered with a certain amount of meal. These winged females fly from tree to tree.



[F. Edenden.]

FIG. 256.—THE MEALY PLUM APHIS
(*Hyalopterus pruni*) on leaves.

In the early autumn they usually all disappear from the plums. Unfortunately, we do not know anything definite regarding the life-cycle. Walker stated that it is the same as the aphis found on reeds, etc., known as *Hyalopterus arundinis*, and I am inclined to think the two are the same. Buckton does not think this likely. I have never been able to detect any sexual generation on plums, and have always noticed that they suddenly disappear from the prunes in late autumn. De Geer, however, stated that he found this aphis on an apricot and describes both winged male and wingless female, and that in September he found an egg with

a woolly coat fixed near a leaf bud.

This may have taken place, but it is certainly not the usual habit. We may safely say that the Mealy Aphis comes to the prunes in summer and leaves them in late autumn. The specimens sent from Scotland were winged and wingless females and pupæ. The winged females were viviparous and their young were deposited on prune leaves and reproduced young again and then died off; no sexual brood occurred.

It has also been found on the peach and nectarine, and in Italy has been observed on grape vines.

It is usually worst on Victorias and Czars, but it may also occur

on Pershore, greengages and damsons. Buckton says it infests many kinds of plums, both wild and cultivated, being common on *Prunus spinosus* and *P. insititia*.

TREATMENT.

This consists of spraying with some wash having soft soap as a base. Frequent use and experiments have shown that it is most difficult to kill with ordinary paraffin emulsion, and almost impossible with quassia and soft soap. It has recently been clearly demonstrated by Mr. Getting that it can easily be destroyed by adding to the paraffin emulsion liver of sulphur at the rate of 1 lb. to the 100 gallons of wash.

Experiments with a patent wash containing this ingredient were also completely successful. Owing to the leaves remaining flat they are easily hit by a wash. Mr. Getting, however, tells me he believes now and then they curl the leaves or else go to leaves curled by *Aphis pruni*.

NATURAL ENEMIES.

This aphid is freely attacked by Chalcid parasites, the pearly dried skins of the parasitised specimens being very noticeable. But in spite of this the aphid often swarms.

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- (3) *Theobald, F. V.* Report on Economic Zoology for the year ending April 1st, 1906, p. 54 (1906).
- (4) *Carpenter, G. H.* 'Injurious Insects and Other Animals observed in Ireland during 1901,' p. 154 (1902).



(F. Edenden.

FIG. 257.—MEALY PLUM APHIS (*Hyalopterus pruni*).

Winged viviparous female, found in November, showing living young within.

THE OYSTER-SHELL BARK LOUSE.*(Aspidiotus ostreaformis. Curtis.)*

This scale insect or Coccid appears to have increased lately in British plantations. During 1906 a very badly infested plum tree was pointed out to me by Mr. Getting of Ross in his plantations, so badly encrusted that it was cut down and burnt. The photograph shows the dense scurfy covering of these scales, completely enveloping the branches. The scale was seen to have spread to some other trees around, and these were treated with all due care. The same scale was twice pointed out to me by growers in Worcestershire (1), and the same wise drastic treatment followed.

In Kent this insect occurs mainly in the Maidstone area and around Sittingbourne; Mr. F. Smith tells me it is of frequent occurrence in the plantations (2). Newstead (3) records it as common in Cheshire, and from Haslemere, Surrey, Lewisham, Bearsted (Kent), and Portarlington, in Ireland. He further says it is extremely local, but where it occurs it is abundant and injurious.

The immature scales are of different appearance to the mature ones, being darker and more uniform.

LIFE-HISTORY AND HABITS.

The scale covering the insect is often somewhat like a small native oyster shell, but it is subject to enormous variation in shape; the young scale being almost round. The scale is flattened, smooth in texture, but shows concentric markings; slightly out of the centre is a circular black spot.

Older scales become more elongate and irregular, and are greyer in colour, especially when they thickly encrust the trees. They then produce a scurfy appearance, but when younger and round in form, they are scarcely noticeable, owing to their approximating the colour of the bark.

At times they are so flattened against the bark that they look almost like the rind. This was the case with the specimens sent from Sittingbourne.

The Oyster-shell Bark Louse attacks plums, apples, pears, apricots, nectarines and peaches. It has also been recorded on currants by Newstead (3). Green (3) found it on heather in Kent. Newstead says it "increases but slowly," but at times it seems to do otherwise, and trees are too frequently killed by it. It certainly spreads slowly,

but from personal observations it seems that when once a tree is attacked it is doomed, unless some treatment is adopted.

Unlike the Mussel Scale, which is found in the egg stage under the "scale" during the winter, the Oyster-shell Bark Louse occurs in the immature male and female condition.

On lifting up one of the scales, say in February, one can easily remove with a pin a small yellow body beneath the scale. This is



[A. V. D. Rintoul.]

FIG. 258.—THE OYSTER-SHELL BARK LOUSE
(*Aspidiotus ostreiformis*).

the female insect not yet mature. Winged males appear in April and early May, and fly around the scale-laden trees. The male is yellow, with transparent wings and a dusky band running across the thorax from the base of the wings.

The females are then fertilised, and numerous eggs are laid, which hatch into little active larvæ in June, and they move over the tree. These soon settle down, and the scale commences to form over them, being quite prominent by October.

TREATMENT.

This consists of spraying in winter with paraffin emulsion, caustic alkali or Woburn washes. But if a tree is badly infested, it is really best to cut it down and burn it. Any young stock showing signs of this scale should be fumigated in winter, before being planted, with hydrocyanic acid gas. Smearing the stems with clay and lime or clay and cow-dung is found to kill this scale.

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- (2) *Theobald, F. V.* Report on Economic Zoology for the year ending April 1st, 1907, pp. 72-74 (1907).
- (3) *Newstead, R.* 'A Monograph of British Coccidae,' vol. I., p. 99 (1901).

PLUM AND APPLE LEAF HOPPERS.

(*Typhlocybidæ*.)

During the summer and autumn of 1906 a number of communications from various parts of Britain were received concerning the damage done and the annoyance caused by the so-called "leaf hoppers." Most orchard trees are attacked, and to some extent bush fruit.

The leaf hoppers in all cases reported and observed proved to belong to three species of the Homopterous family *Typhlocybidæ*, namely, *Typhlocybus querens*, Fabricius, *Chlorita flavesceens*, Fabricius, and *C. viridula*, Fallen.

Specimens of the two last were kindly examined for me by Mr. Distant and I gather from his remarks that he is not satisfied with their true specific distinction.

As no reference can be found to any of these insects in the literature on Economic Entomology in this country, the following notes on their life-history, the damage caused by them, and the means of holding them in check, is given somewhat fully, particularly as the damage they have done has in some cases been very great.

Some bad attacks were also recorded from Kent and Sussex in 1907.

In other parts of Europe, and in America, there are many instances of damage caused to crops and fruit by both of the genera of *Typhlocybidæ* that are mentioned here (3, 15, 21).

Several growers I have consulted have noticed the damage caused by these leaf hoppers on fruit for many years.

Edwards (6) does not appear to have been acquainted with the economic literature of this subject, for he states in his work on the Hemiptera-Homoptera of the British Isles (p. 3) that "none of the Homoptera-Cicadina can be said to be of any economic importance in Britain ; certain species, as *Philænus spumaria*, *Chlorita viridula*, *Eupteryx auratus*, etc., sometimes swarm in gardens, and elm and beech trees are generally tenanted by countless numbers of *Typhlocybiæ*, but it does not appear they do any real harm in any stage."

The *Typhlocybiæ* are small leaf hoppers, which form a very homogeneous group, and some, such as the *Typhlocyba quercus*, are very gaily coloured ; others, as the two *Chlorita*, are more uniform in appearance.

No less than twenty species of *Typhlocyba* are known to occur in Britain. One species is described from plums (*T. pruni*, Edw.), another from nuts (*T. avellanae*, Edw.). Neither of these have been so far observed by me on fruit trees in any numbers, and in many orchards and plantations visited none could be found at all.

It is strange that one of the species that has done so much harm to fruit trees should be an oak feeder. At least, it has been identified as such by Mr. Distant, and it certainly answers the description of *Typhlocyba quercus* given by Edwards, although his figure does not quite agree with any specimen I have. The series in the Douglas and Scott collection in the British Museum, however, all agree with those that have been sent me.

The damage done by these leaf hoppers is very marked, and has been referred to by various writers abroad.

In the case of apple and plum the insects, by means of their probing proboscides constantly being inserted into fresh tissue and constantly sucking out the sap, produce on the leaves, first, minute pale spots, which gradually increase until the leaves become more or less entirely silvery green, or grey, or marbled. To such an extent have I seen this effect that anyone would have thought, at a distance, that the trees were suffering from Silver Leaf disease.



[A. V. D. R.]

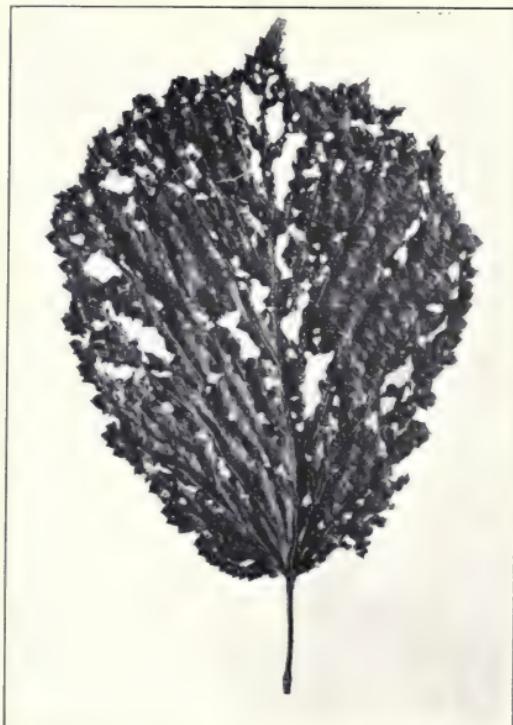
FIG. 259.—DAMSON SPRAY, SHOWING

DAMAGE BY LEAF HOPPERS.

Note pale silvery hue of leaves.

The *Chloritas* and the *Typhlocyba* had all the same effect on apple and plum leaves.

On cobs and filberts the effect is not nearly so marked in this respect, but when the young leaves are punctured the result is equally striking, though very diverse—they become pierced with irregular slit-like holes (Fig. 260). This is caused by the young tissue being damaged and splitting on further growth. The mottling



(A. V. D. Rinton).

FIG. 260.—NUT LEAF DAMAGED BY LFAD HOPPERS.

and paleness of the foliage is the most marked feature of their attack, however.

The result of this damage is that the leaves lose their vitality and cease to exercise their proper functions, fall prematurely, and in bad cases of attack the fruit withers and drops. The growth of the trees is also checked.

The life-history of the *Typhlocyba* and *Chlorita* is slightly different.

THE OAK AND FRUIT LEAF HOPPER.

(*Typhlocyba quercus*, Fabr. = *Typhlocyba flammigera*, Amyot.)

Like all members of this family, the insect passes the winter in either the adult or nymphal stages. Hibernation takes place in any sheltered position. One may find them amongst fallen leaves at the foot of hedgerows, in box hedges, amongst moss and lichens on trees, and abundantly amongst conifers. In spring they appear again, and feed upon the young leaves. In June they are first noticed in numbers; possibly between their exit from winter quarters and June a generation appears. It is not until July that any marked damage is done to the leaves of apple, plum and damson; then all stages of the insect can be found at once. The adult (Fig. 261) may be told by its beautifully-marked anterior wings, with six bright orange and vermillion spots, on a milky - white ground, and with a large dusky network at the apex.

Their length varies from 3 to 3.9 mm. Both nymphs and adults feed mainly on the underside of the leaves, but by no means always.

They are not very active, and can easily be taken at rest on a dull day. When disturbed they take a leap from the leaf, and then using their wings, often fly a couple of feet or so away.

Egg-laying seems a laborious task. By means of a saw-like structure the female cuts a slit into the under epidermis, and places one or more eggs just beneath it. A very minute and faint oblong spot marks where they have been laid.

The ova are very delicate, white, and oblong-oval in form, somewhat curved on one side, and blunt at each end. When nearly ready to hatch they may be seen with a strong lens under the epidermis, their position being plainly marked by the dark eye spots of the embryos. Length 0.04 mm.

Eggs under observation were found to hatch in four days, but how long they had been laid was not known. Slingerland (15) shows that the American Grape Vine Leaf Hopper (*Typhlocyba comes*) remains two weeks in the egg stage, and it is quite likely this is about the period taken by *Typhlocyba quercus*.



[A. V. D. R.
FIG. 261.—OAK LEAF HOPPER
(*Typhlocyba quercus*).]

The young emerge on the underside of the leaf, and grow rapidly. There are four moults in the nymph stage. At first the young are very pale, but gradually become yellowish as the wing buds develop. The whole period of growth lasts from five to six weeks, the complete life-cycle probably taking fifty days.

They may keep on breeding until the first week in October, but in very small numbers after the middle of September.

Until they are mature these leaf hoppers are very sedentary, and even when adult do not jump as do other members of their tribe.

The distribution of *Typhlocyba quercus* in Britain is probably very wide. Edwards (6) gives the following localities:—Norwich and Cotswold districts, Ireland (Haliday), Renfrewshire (Young), Dallington Forest, Totteridge, Barnet (Butler), Glanvilles Wootton (Dale).

During 1906 and 1907 specimens were received from or taken in various places in Kent, Surrey, Sussex, Devonshire, Somersetshire, Worcestershire, Herefordshire, Monmouthshire, Huntingdonshire and north Wales.

Amyot (2) (*Ann. Soc. Ent. France*, II., se. V., pp. 230–495) describes this insect as *T. flammigera*.

THE YELLOW LEAF HOPPERS.

(*Chlorita flavescens*,* Fabr., and *C. viridula*, Fall.)

Two species of *Chlorita* occur in abundance, namely, *C. flavescens*, Fabricius, and *C. viridula*, Fallen. Of these two, the latter seemed by far the most abundant, but both usually occurred together. The differences lie mainly in the male genitalia, but, roughly, when fresh they may be separated by the pale area on the anterior wings, the so-called suprabrachial area being hyaline throughout in *flavescens*, hyaline at the apex only in *viridula*.

These insects swarm in greater numbers than the *Typhlocyba* in most districts from which reports have been received.

One correspondent wrote from Southfleet on the 6th of August, 1906, that his pickers had refused to work owing to the swarms of leaf hoppers, which got into their eyes, ears, nose, and were drawn in at every breath. They had appeared in this manner several years

* The following is the synonymy of this species:—*Typhlocyba rosæ*, H. Sch. (D. Ins., p. 124–1). *Eupteryx flavescens*, Marsh, Ent. Mo. Mag., III., p. 220–6. *Typhlocyba flavescens*, Flor. (Rh. L., II., p. 394–9). *Cicadula flavescens*, Sahlb. Not. Feim., XI., p. 161–3. *Chlorita flavescens*, Fab. Gli. Insetti. No., p. 154, vol. IV.

previously. The grower wrote later that he had watched for them, and cleaned the trees with soft soap and quassia. They all fell to the ground, and he thought they had been made an end of, but on the following day they had revived, and were all up the trees again.

The effect of these Yellow Leaf Hoppers on plum and apple is very similar to that of the *Typhlocyba*, but in nuts they produced a curious split and jagged appearance of the leaves (Fig. 260).

In life-history they differ from the pretty *Typhlocyba*. Like the latter, however, they hibernate as adults and nymphs, and in very much the same positions; in fact, they are frequently found in company during the winter.

The earliest time they have been noticed on nuts is the 2nd of May,



[F. Edenden.

FIG. 262.—YELLOW LEAF HOPPER (*Chlorita flavescens*).

(Greatly enlarged.)

but doubtless they are about before then. Eggs are laid in June, and another brood appears in August. Some eggs were brought me as late as the 23rd of October, and I saw one or two still unhatched on the 17th of November. A single individual was seen active early in December, the weather having been particularly open. I believe these *Chlorita* have three, not two, broods. The eggs are laid by the female on the undersides of the leaves, not under the epidermis, as in the former genus. The egg is white, broadly spindle-shaped, with prominent ribs running from pole to pole. Length 8 mm.

The ova hatch in August in about eleven days, and the nymphs at once commence to feed (18).

The nymphs have been observed to moult five times, and reach maturity in about five weeks, a few in thirty days (18). When first hatched they are very pale, almost white, but darken as they grow,

becoming pale yellowish-green. At each moult the insect fixes itself firmly to the underside of the leaf by its claws and proboscis. Unlike the nymphs of *Typhlocyba*, they are very active and run rapidly, but do not jump like the adults.

The adult *C. viridula* is green, with pale marks.

C. flavescens is more of a yellowish-green.

The distribution of *C. flarescens* in Britain is given by Edwards as Norwich and Cotswold districts; Dublin (Carpenter); Hastings (Butler); Glanvilles Wootton (Dale).

One could add some hundreds of localities. Suffice to say that it has occurred in such numbers as to cause damage in several localities in Kent, Sussex, Herefordshire, Worcester-shire and Huntingdonshire.

The allied species is also recorded from the Norwich and Cotswold districts; Pitlochry (Norman); Ardara (Johnson); Ireland (Haliday); Glanvilles Wootton (Dale); Hurst Green, Hastings, Ewhurst and Chingford (Butler). Specimens have been received in all cases from the same localities as *flavescens*.

They are both probably found throughout the whole country.

NATURAL ENEMIES.

Quite a number of *Chloritæ* and *Typhlocybæ* are found to be attacked by parasites.

Saunders (14) records a Strepsipteron, *Eleuchus tenuicornis* (of Kirby) as a parasite of the allied *Liburnia*, and figures this parasitic coleopteron emerging from the host.

The two most important natural enemies of the *Typhlocybidæ* are the Proctotrupids, of the genus *Aphelinus*, and Pipunculid larvæ. Quite a number of the *Chloritæ* and *Typhlocyba* examined from all



[A. V. D. Rintoul.]

FIG. 263.—LEAF HOPPERS (*Chloritæ*) ON APPLE LEAF.

parts of Britain in 1906 showed the extraordinary parasitic Proctotrupids of the genus *Aphelopus*. The infected individual looks as if its abdomen were bifurcated, for the "gall" produced by the parasite equals or rivals in size the abdomen of the host.

These "galls," for they are nothing more or less than animal galls, have been previously noticed by Giard (7) in France, and he speaks of them as "*Thylacia*." These growths are formed by a gradual dilatation of the skin. This sac is attached to the back of the insect. In it lies the *Aphelopus* larva, and here it passes the later stages of its development.

Frequently I have found these sacs break away and fall to the earth; the homopteron flies on unconcerned, just as it seems to have been by this additional load. Giard states that the host may die. More often this sac remains attached to the host until the Proctotrupid larva escapes, and falls either to the ground or on to the branches. It then pupates in a coarse case very similar to that formed by the Braconidae. The *Aphelopus* larva is long, and has a transverse row of long stiff bristles on each segment.

The effect of these hymenopterous parasites is very marked. Giard refers to them as causing parasitic castration (Castration parasitaire). They reduce the size of the external genitals, frequently to such an extent that only vestiges remain, and at the same time alter their form.

The other important group of parasites are the larvae of the dipterous family of *Pipunculidae*.

Several larvae were found in *Chloritae* sent from Kent belonging to a species of *Atelenura*. In France the species found by Giard working with the Proctotrupids appears to be *Atelenura spuria*, Meigen. The effect of these larvae is also to produce parasitic castration. I do not know if any changes take place in the female hoppers.* The *Atelenura* larva lives within the body of the Typhlocybidæ. The parasitised abdomen swells to such an extent that it passes well beyond the wings, so that an invaded specimen can at once be told.

* Giard distinctly states so.



[F. Edenden.]

FIG. 264.—YELLOW LEAF HOPPER
ATTACKED BY A PROCTOTRUPID,
A, thylacia.

When mature the parasite issues from the middle segments, always dorsally, and falls to the ground and becomes a naked pupa on the surface.

Atelenura spuria is known usually as *Chalarus spurius* (*Chalarus*, Walker, 1834, *Atelenura*, Macquart, 1835).

It is also found in America (New Jersey and New Hampshire) (*vide* Cat. N. Amer. Dip., p. 342. J. W. Aldrich, 1905) (1).

Boheenaus also has found *Pipuncula fuscipes*, Fall., infesting *Cicadula virescens*, Fall. It is thus probable that *Pipunculidae* generally are parasitic on the homopterous *Cicadulidae*, and the Proctotrupians of the family *Dryinidae* and *Aphelinidae* are parasitic on *Jassidae* and *Typhlocybidae* respectively.*

PREVENTION AND TREATMENT.

The nymphs of these leaf hoppers may be destroyed by washing with dilute paraffin emulsion, particularly when young.

Of the various strengths experimented with, the following formula was the lowest found successful, and thus adopted :—

Paraffin (White Rose)	.	.	.	3 gallons.
Soft Soap (Chiswick)	.	.	.	10 lbs.
Water	.	.	.	100 gallons.

This, if sprayed with a fine nozzle, was found to have no effect, nor were any of the other formulæ used until such a quantity of paraffin was employed as to do more harm than the hoppers.

The success in destroying the nymphs lies in giving the trees a good soaking. In America (15) they have found that 1 lb. of whale oil soap to 10 gallons of water enough to kill the nymphs of the allied *Typhlocyba comes*. With soft soap this was not sufficient.

In all cases two washings were found necessary, partly on account of fresh hatchings. The second should be done two weeks after the first.

The adult hoppers can also be destroyed by spraying; they must first be knocked off the trees by a plain, not strong, soft soap wash, when they will be found, as Mr. Chambers describes, lying as if dead on the ground; they can then be further sprayed on the ground with strong paraffin emulsion (25 per cent. paraffin). This method, which is employed in America, was found to be completely successful here.

* Perris found *Dryinus pedestris*, Dalm., on *Athyssanus maritimus*, Perris; Mik found *Gonatopus pilosus*, Thoms. on *Deltocephalus xanthoneurus*, Fabricius.

No wash will kill the adult hoppers on the leaves unless it is so strong that the foliage is destroyed by it. The adults may be caught in large numbers on tarred cloths, stretched on a light wooden frame and held on each side of the trees, which are then jarred so as to make the insects move from shelter and thus get caught in the tar. This is a laborious undertaking, and is no more beneficial than the washing treatment mentioned.

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THE RED SPIDER ON PLUMS.

(*Tetranychus telarius.* Linn.)

Whitehead (1) describes an attack of Red Spider on plums and damsons which was specially prevalent in 1886.

The leaves became duller and duller in hue and many fell off,

whilst the fruit became stunted and some of it dropped off. He also describes the webbing and spherical eggs, some white, others a semi-transparent golden hue.

Whether or not this was the true *T. telarius* I do not know, or whether it was the Hop Red Spider (*T. malrae*). I have never seen any such attack, and the district where it took place is not recorded.

The usual Red Spider found on plums is *Tenuipalpis glaber*, which



[W. H.
FIG. 265.—RED SPIDER
(*Tetranychus telarius*).



FIG. 266.—RED SPIDER EGG.
(*T. telarius*).

often occurs in swarms, but I have been unable to trace any damage done by it. It winters in the egg stage as small globular red bodies, often so thick together that the shoots look red. This species forms no web.

TREATMENT.

Would be the same as for the Red Spider on gooseberry, but they hatch out much later.

REFERENCE.

Whitehead, Sir C. Report on Insects Injurious to Fruit Crops, p. 107 (1886).

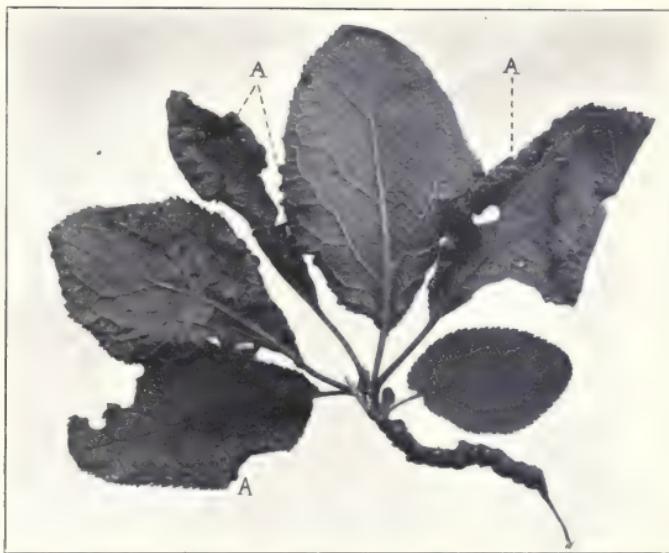
THE PLUM LEAF GALL MITES.

(*Eriophyes phloeocoptes*, Nalepa, and *E. padi*, Nalepa.)

Two kinds of galls are often common on the leaves of *Prunus*. They are produced by gall mites, formerly known as *Phytoptus pruni* and *P. attenuatus*, now under the names given above. The

first-named is in the form of small pale wart-like blisters on the upper surface of the leaves of plums, which are hollow beneath, the colour above may sometimes be reddish and the galled areas may become slightly hairy.

The second I have usually found on the damson and bullace, and also on the wild sloe; the galls are situated at the edges of the leaves, which become swollen in attenuated patches.



[F. Edenden.]

FIG. 267.—PLUM LEAVES ATTACKED BY GALL MITES.

Sometimes they occur in sufficient numbers to seriously harm the foliage.

The minute mites are with difficulty found in the galls, owing to their small size and transparent nature.

They leave the galls when the foliage ripens and enter the buds, where they pass the winter just under the scales. Reproduction takes place in the galled areas. A considerable amount of the first is seen in parts of the Midlands, and the latter is quite common in Kent on damsons and bullace. The last-named I have found may be checked by spraying in winter with lime, salt, caustic soda and sulphur wash (*vide* appendix. Washes).

I have frequently noticed that when the plum or pear buds are full of the hibernating *Eriophyidae* that Tits and Sparrows are

particularly fond of the buds, and I have known a plum tree cleared of the pest in this way. Bullfinches, however, have no choice; all



[S. U. Pickering.]

FIG. 268.—PLUM TREES DISBUDDED BY BULLFINCHES.
The buds often full of Plum Leaf Mites, but it is only by chance
Bullfinches attack them.

buds are alike to them, and the result is often as seen in the photograph (Fig. 268) sent me by Mr. Pickering.

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- (3) *Amerling, Geo.* Aufs. S. 131, 138, 162.

BEETLE MITES.

(Oribatidae.)

These mites (Fig. 269) take their popular name from their hard shiny nature. Some are black, others red or brick-dust red.

One species, *Oribata lapidaria*, is very frequent on fruit trees, especially plums and damsons.

They are frequently thought to be injurious, but no proper evidence has yet however been brought forward to prove this, and in all cases investigated by the writer they were found not only not to be injurious, but to be actively beneficial, for they feed on lichens and fungus spores. They have been watched feeding upon the fruit organs of the canker fungus (*Nectria ditissima*).

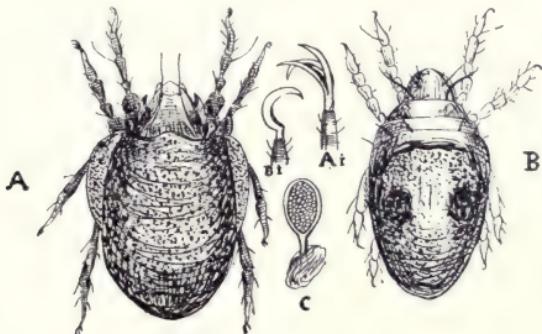


FIG. 269.—BEETLE MITES OR *Oribatidae*.
A, adult *Oribata lapidaria*; B, nymph; C, stigmatic organ;
Ai and Bi, claws.
(From 'A Text Book of Agricultural Zoology.' Theobald.)

They cluster together in dense masses, hiding under moss, bark, sacking, etc., and appear to hibernate in the adult condition.

The species I have taken to be (1) *Oribata orbicularis*, Koch, is apparently the species named here, so I am informed by Mr. Cecil Warburton.

The mites recorded by me from chestnuts and fruit in Sussex were referred to Albert Michael and he identified them as *O. orbicularis* (2), so that we appear to have at least two species on fruit.

In 1904 they were very abundant in parts of Kent.

Mr. Howard Chapman wrote that at Dartford he found "more on plums than on pears and apples. On plums (Victorias and Orleans), after taking the grease bands off, there are noticed quite a

ring 2 or 3 inches wide of these creatures underneath the paper, so it appears the band is a great harbour for them." In the same year a nurseryman, writing from Woking, stated "that plums and young standard apples are covered with the insects." Information sent that they were not injurious brought the following reply: "I have very carefully watched them on the trees, and I believe your statement to be quite correct as to their being, if anything, beneficial; they were feeding on the green growth of the trees, and were only found where there was any to feed upon."

The red ova of these mites were also received from Ross, on apple, pear and plum in the same year, where Mr. Getting informed me they were appearing in great numbers.



[W. H. H.]

FIG. 270.—LARVAL BEETLE MITES
(*Oribatidae*).
(Enlarged.)

The globular brick-dust shiny red eggs are deposited in masses side by side, often giving the trees a rusty-red appearance. The date of hatching seems variable. In 1904 eggs were sent from Hereford on the 20th of March. In the same year they had all hatched in Kent early in the month (3).

They still further increased in Kent in 1906 (4), when they occurred in countless numbers in very many orchards. They were noticed at Marden occurring in masses under the bark of apple trees in November,

also in many localities around Maidstone and in Thanet, and also near Malvern.

Ormerod (5) refers to *O. lapidaria* as occurring in vast numbers on the stems of *Nyleborus*-infested trees, and suggested that they might be preying upon the "Ambrosia" fungus of the beetles, and thus would be acting beneficially.

Speaking generally, we may say that these acari are beneficial.

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[F. Edenden.

FIG. 271.—BEETLE MITE EGGS (*Oribatidae*).
(Enlarged.)



FIG. 272.

BEETLE MITE EGGS (*Oribatidae*).
(Slightly enlarged.)

PINEAPPLE.

LIST OF INSECTS INJURIOUS TO PINEAPPLE.

HEMIPTERA.

WHITE SCALE (*Diaspis bromeliae*. Kerner). Foliage and Fruit, p. 407.

BROWN SCALE (*Aspidiotus bromeliae*. Newstead).

MEALY BUGS (*Dactylopius citri* and *D. longispinus*). - Foliage and Fruit, p. 483.

The only pests I know of on hothouse pines are the four Coccids mentioned above. Reference is made in some gardening works to the Brown Scale, which I take to be *A. bromeliae*.

THE WHITE PINEAPPLE SCALE.

(*Diaspis bromeliae*. Kerner.)

This is a well-known pineapple pest and is quite frequent on imported fruit. It is well established in this country, and has been since 1841, when Curtis first called attention to it in the Gardeners' Chronicle. Most growers of hothouse pines are, or have been acquainted with it, and it is referred to in all books on fruit culture as the White Scale. This insect occurs all over the plant, often thickly encrusting the fruit, especially getting into the deep sutures and often deep in the perianth. When on the leaves the scales are often almost hidden under a scurfy epidermal layer. The female scale is circular and flat and semi-transparent; some almost pure white; the "spot," or exuviae, dusky yellowish-brown. Diameter often nearly $\frac{1}{8}$ inch. The female under the scale is pale yellow. The male scale is common; it is only $\frac{1}{2}$ inch long, elongated, with woolly fibres and with brown exuviae in front. The winged male is orange yellow.

This insect is found all over Europe in hothouses, also in America and Mexico, and I received some a few years ago from Jamaica,* where it was doing much damage.

Besides occurring on pineapples, it is recorded on libiscus, canna, billbergia, olea and ivy.

The scales are not only disfiguring to the pineapples but cause the fruit to rot. Their partial burrowing under the skin makes them somewhat difficult to destroy.

* First Report on Economic Zoology (British Museum N.H.), p. 135 (1903).

TREATMENT FOR WHITE SCALE.

Three things seem to be done by growers in this country:—

(1) Spraying or dipping in warm water; never over 130° F., best at 115° F.

(2) Treating with paraffin emulsion.

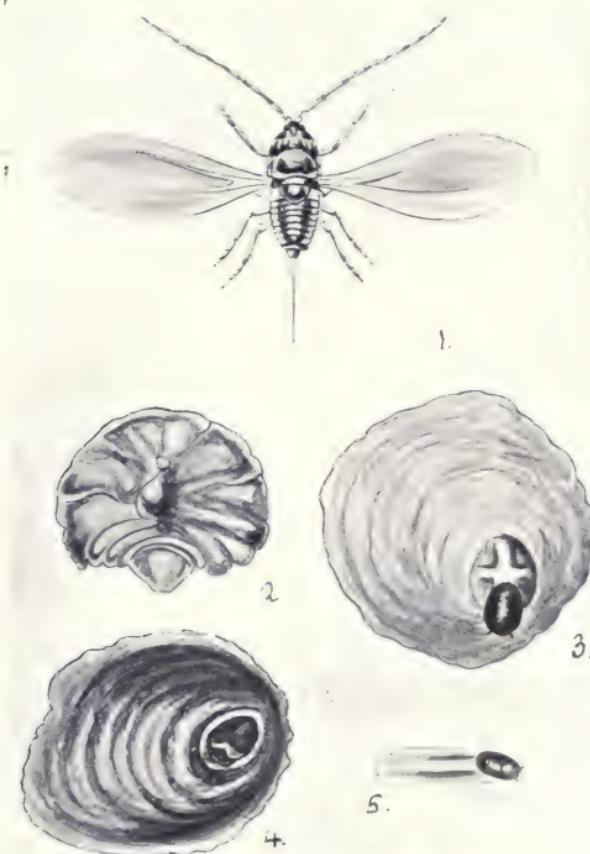


FIG. 273.—PINEAPPLE SCALES.

- 1, *Diaspis bromeliv*, ♂, $\times 25$; 2, adult female, $\times 35$; 3, puparium of adult female, $\times 29$; 4, *Aspidiotus bromeliv*, puparium of adult female ($\times 25$); 5, puparium of male, $\times 20$.

(After Newstead.)

(3) Placing the affected plants, head downwards, over a bed of fermenting horse dung in a closed frame for an hour, and then taking the plants out and washing in plain water.

QUINCE.

INSECTS INJURIOUS TO THE QUINCE.

LEPIDOPTERA.

- LARGE TORTOISESHELL BUTTERFLY (*Vanessa polychloros*. Linn.). Foliage, p. 186.
 WINTER MOTH (*Cheimatobia brumata*. Linn.). Foliage, p. 50.
 MOTTLED UMBER MOTH (*Hybernia defoliaria*. Clerck.). Foliage, p. 58.
 GOLD TAIL MOTH (*Porthesia similis*. Fues.). Foliage, p. 27.
 CODLING MOTH (*Carpocapsa pomonella*. Linn.). Fruit, p. 69.

COLEOPTERA.

- BARK BEETLE (*Scolytus rugulosus*. Ratz.). Bark and wood, p. 111.
 BLOSSOM BEETLES (*Meligethes spp.*). Blossoms, p. 115.

HYMENOPTERA.

- PEAR AND CHERRY SLUGWORM (*Eriocampa limacina*. Cameron). Foliage, p. 334.

Note.—The above have been particularly mentioned on the Quince. Probably all the Apple pests attack it, and some of the enemies of the Pear.

RASPBERRY.

INSECTS INJURIOUS TO THE RASPBERRY.

LEPIDOPTERA.

- THE GRIZZLED SKIPPER BUTTERFLY (*Syrichthus malvae*. Linn.). Foliage, p. 420.
 THE GARDEN SWIFT MOTH (*Hepialus lupulinus*. Linn.). Rootage, p. 446.
 THE DOT MOTH (*Mamestræ persicariae*. Linn.). Foliage, p. 264.
 THE BUFF ARCHES (*Thyatira derasa*. Linn.). Foliage, p. 419.
 THE PEACH BLOSSOM MOTH (*Thyatira batis*. Linn.). Foliage, p. 419.
 FAN FOOT MOTH (*Zanclognatha tarsipennalis*. Tr.). Foliage, p. 420.
Melanthis albicillata. Linn. Foliage, p. 420.
 THE RASPBERRY MOTH (*Lampronia rubiella*. Bjer.). Shoots, p. 416.

COLEOPTERA.

- THE RASPBERRY WEEVIL (*Otiorhynchus picipes*. Fab.). Foliage and Shoots, p. 425.
 RED-LEGGED WEEVIL (*Otiorhynchus tenebricosus*. Herbst.). Foliage and Shoots, p. 428.
 STRAWBERRY AND VINE WEEVIL (*Otiorhynchus sulcatus*. Fab.). Foliage and Shoots, p. 460.
 BLACK ANTHONOMUS (*Anthonomus rubi*. Herbst.). Blossoms, p. 461.
 ROSE OR GREEN CHAFER (*Cetonia aurata*. Linn.). Roots and Foliage, p. 429.
 COCK CHAFER (*Melolontha vulgaris*. Fab.). Roots and Foliage, p. 431.
 SUMMER CHAFER (*Rhizotrogus solstitialis*. Fab.). Roots and Foliage, p. 433.
 RASPBERRY BEETLE (*Byturus tomentosus*. Fab.). Blossoms and Fruit, p. 420.
 GROUND BEETLE (*Harpalus ruficornis*. Fab.). Roots and Suckers, p. 455.

HYMENOPTERA.

- RASPBERRY EMPHYTUS (*Emphytus cinctus*. Linn.). Snags, etc., p. 434.
 Several others occur (*vide p. 438*).

DIPTERA.

- CANE GALL FLY (*Lasioptera rubi*. Schrank). Canes, p. 439.

HEMIPTERA.

- THE RASPBERRY APHIS (*Siphonophora rubi*. Kalt.). Foliage, p. 440.
 THE ALLIED RASPBERRY APHIS (*S. chelidonii*. Kalt.). Foliage, p. 441.

THE RASPBERRY MOTH.

(*Lampronia rubiella*. Bjerck.)

The larvae of this small moth frequently cause much havoc in raspberry plantations, being most destructive to the canes. Many gardens and plantations are said to be quite free from this pest, but frequently a few may be found if careful search is made, and these may, under favourable conditions, increase rapidly so that in a year or two a plantation may be seriously threatened. Many patches of raspberries are annually attacked, and in some years the crop has been entirely lost.

The small caterpillars of this moth are usually called the Raspberry Stem-bud Caterpillar or Red Raspberry Grub. These larvae

feed on the pith inside the terminal shoots, which flag and then die away; it will also be noticed that the base of the buds has been eaten away to such an extent that neither foliage nor blossom appears, the shoots dying gradually. In most cases a distinct hole may be seen at the bases of the buds.

So far as I know all varieties of raspberries are attacked, and they have been found on the native blackberry; very probably therefore they will attack the cultivated blackberry and loganberry. This raspberry pest occurs in Kent, Worcestershire, Gloucestershire, Warwickshire, Cambridgeshire and Buckinghamshire. I have also seen it in Surrey.

There are no records of its damage in Herefordshire, but probably it exists there in small numbers.

The first and best account of this moth was given by Professor Westwood (1). To this nothing of importance has since been added, except by Dr. Chapman (2).

Synonymous names for this species are:—*Tinea corticella*, Linnaeus; *Tinea rubiella*, Bjerkanter; *Alucita variella*, Fabricius; *Alucita multipunctella*, Duponchel; *A. fischerella*, Sodoffsky; *Glyphipteryx variella*, Stainton.

LIFE-HISTORY AND HABITS.

The Raspberry Moth is $\frac{1}{4}$ inch long, the wing expanse less than $\frac{1}{2}$ inch; some specimens are very small. The general colour is brown, the front wings have yellow spots, of which two on the inner border are the largest, these meet with those of the



[F. E.]

FIG. 274.—RASPBERRY
MOTHS.
(Natural size.)

other wing, when the wings are folded and form two prominent yellow areas; on the costal border are three smaller, yet prominent spots, there are two or three still smaller basal ones; at the apical border is a row of four small yellow specks and now and then a smaller yellow spot or two are found towards the middle of the wing area; the hind wings are paler brown and uniform and the fringes pale; when quite fresh the wings have a satiny sheen over them. The head is yellowish; antennæ brown. Legs brownish and the body brown. They fly both by day and by night and may be found hovering round the canes from the end of May into the month of June. They may often be seen settled upon the flowers where they deposit their eggs. Exactly how many ova each female deposits is not known, but pregnant females have been observed with eighty to ninety in them.

The egg stage lasts from five to seven days as a rule, but may in some instances be less.

The larvæ at once enter the white core of the "berry" or receptacle, here they remain for some time, taking very little nourishment, for no damage is done in this stage, the fruit not being in the least affected; a small passage marked by a dark line may sometimes be noticed, which nevertheless does not stop the development of the collection of fruitlets

around the core. Before the fruit is ripe the small pallid caterpillars leave the receptacles and either fall or crawl to the ground. It is also said that they lower themselves to the earth by means of silken threads. These small larvæ then crawl about until they find some convenient shelter in which they spin a small flat cocoon, composed of dull white or grey silk. These cocoons vary from $\frac{1}{10}$ to $\frac{1}{12}$ inch in diameter. The usual position of these cocoons is either under the rough rind of the canes or in cracks and crevices of the stalks; they also occur under stones or pieces of wood lying about in the plantations. Under the protection of the cocoons and outside shelter the larvæ remain all the



[A. V. D. Rintoul.

FIG. 275.—NORMAL AND DAMAGED (A)
SHOOTS OF RASPBERRY.

winter, and in spring they resuscitate and crawl forth into the open. They then commence a fresh stage of life, entering the buds at their base and feeding upon them. In most years they leave the cocoons, and commence crawling about towards the end of March, and by the beginning of April many have commenced their ravages of the developing buds. Dr. Chapman (2), who worked out the life-history of this pest, states that in 1892 the caterpillars were found in the buds on the 10th of April. In 1899 I noticed them at work a week earlier in Kent.

The larva becomes pink, and as it grows it assumes a distinct red colour. The head is dark and shiny, quite black in some specimens, deep shiny brown in others; the first segment has a black or deep brown thoracic shield divided into two parts by a pale median line; the anal segment also often appears darkened; the six true (jointed) legs are deep, shiny brown, the four pairs of prolegs pink, and also the anal pair.

When mature the caterpillar reaches $\frac{1}{2}$ inch in length. It feeds not only on the buds, but as they open it tunnels up the pith, and so causes the shoots to flag. Many buds scarcely develop, others do so a little and die, yet others grow out well and only flag later. In any case the attacked buds and shoots, both leaf and blossom, perish sooner or later.

As soon as the caterpillar is mature, it scoops out a cavity, either in the pith of the cane just below the base of the bud or shoot, or in the shoot itself where it springs from the cane.

The pupa is $\frac{1}{4}$ inch long, reddish-yellow in colour, with pale pink abdomen and pale wing cases; on the back of the anal segment is a spine; the apex tapers to a fine point. The pupa lies close to the surface, and when the moth is ready to emerge I have always found that the pupa pushes its way out of the nest through a small hole, the shell then ruptures and the moth crawls out and rests for a few hours whilst its wings unfold and harden. The pupal stage lasts from nineteen to twenty-three days as a rule, but during the summer of 1903 some did not emerge for four weeks. The caterpillars may leave the shoots prior to pupation and spin a delicate cocoon between the dry leaves of the shoots they have destroyed.

PREVENTION AND TREATMENT.

The abolition of stakes in raspberry plantations is very essential where this pest is present. The old stakes should be burned in the winter, and then numbers of the hibernating larvae will be killed.

After a bad attack the canes should be cut right back and burned, and thus many more are destroyed.

There still remain those that hibernate in the ground and under rubbish, these may anyhow be lessened by deeply forking the ground round the canes, or prong-hoeing it, and then spreading soot, lime and ashes around the base of the canes in spring and hoeing it in.

Those that hibernate in the crown of the stock, and near it and under rubbish, may also be destroyed as mentioned by Dr. Chapman, namely, by raking away the surface and then earthing the stock up again. This would do very well on a small scale, but would be a troublesome procedure in large plantations.

It has also been suggested that where a few canes only are allowed to remain, that these should be smeared with soft soap with a brush upon the lower part of each cane in March, so as to catch the larvæ in their ascent. If this were done, it should be applied some way up the canes, so as to catch those that have hibernated under the rind. To be of any use, the mixture should be smeared on early in March and renewed in two weeks. Mr. Martin of the Toddington Fruit Plantations has found smearing an excellent preventive. There is no reason why arsenical spraying should not be helpful in this attack. Two good sprayings with arsenate of lead, one as soon as the larvæ are likely to be appearing, and another about a week after the first, would probably poison the caterpillars on eating their way into the buds. Arsenate of lead will remain on the plant some time.

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OTHER LEPIDOPTERA FEEDING ON THE RASPBERRY.

None of the moths in this list have ever been known to do any harm, but now and again the larvæ are sent in because of their devouring a small quantity of the foliage.

The Buff Arches (*Thyatira derasa*); normal food bramble. Larva dark brown, with a white spot on each side of the fifth, sixth and seventh segments; occurs in September; the moth in June and July.

The Peach Blossom Moth (*Thyatira batis*) occurs on blackberry,

raspberry and peach. The larva is found in September on the leaves. It is reddish-grey mottled with brown, with a prominence on the back of the third segment, and a smaller one on the sixth to tenth segments. The moth occurs in June and July.

The Dot Moth (*Mamestra persicaria*) frequently may be found on the lower leaves in caterpillar stage from July to October.

The Fan Foot Moth (*Zanclognatha tarsipennalis*). The chief food plant of the caterpillar is the raspberry, upon which it frequently occurs in small numbers. The larva is dull grey, with black triangular-shaped marks along the back, and the hind segment has four white spots. It is found in September and October, and mostly feeds amongst dried leaves. The pupa is formed in a cocoon amongst leaves on the canes. The moth has the fore wings brown with three dark transverse lines, the basal one curved, the second waved and broken, the third nearly straight, and there is also a small crescent-shaped spot between lines one and two; the hind wings are paler basally and dusky towards the margin. Length of expanded wings about 1 inch. Found in June and July.

Melanthis albicillata in its larval stage feeds on raspberry and bramble; it is green, with triangular-shaped spots on the back of the fourth to tenth segments and white lateral lines; it is found in the autumn and does no harm at all.

Occasionally the larva of the Grizzled Skipper Butterfly (*Syrichthus malvae*, Linn.) occurs on the raspberry; it is green or brown, with dark dorsal line, two white lines on the back, and one on each side. It is found in April and May, but never occurs in sufficient numbers to do any harm.

THE RASPBERRY BEETLE.

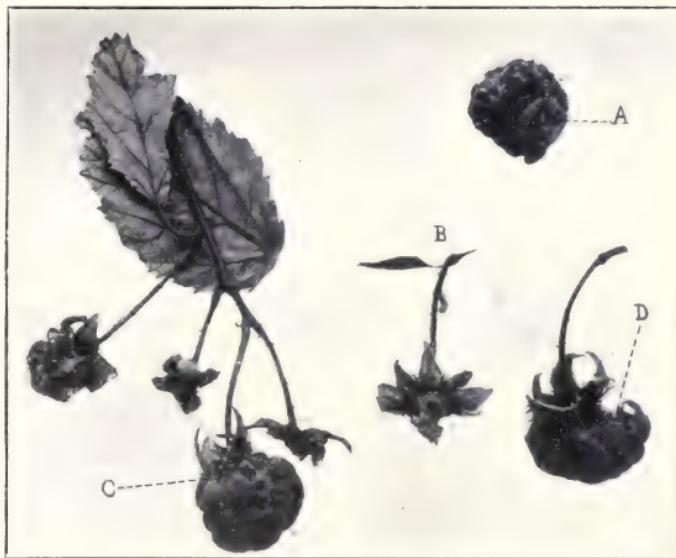
(*Byturus tomentosus*. Fabr.)

There is no insect enemy so serious to raspberries as the Raspberry Beetle (*Byturus tomentosus*). It has, as one might imagine, attacked loganberries also, and to such a serious extent as to threaten their cultivation. As many as six larvae have been found in one loganberry. It has been known for a great many years, not only to gardeners and fruit-growers, but also to the general public on account of the larva—the so-called Raspberry Maggot—being so often found in the fruit at table, especially when the fruit is picked on the strig. Gardeners know it by the popular name of the “Raspberry Bug.”

Kirby and Spence, in 1827, wrote of this beetle, that “the foot

stalks of the blossoms are occasionally eaten through by a minute animal (*Byturus tomentosus*), which I once saw prove fatal to a whole crop, and of which the larva feeds upon the fruit itself."

It is by no means infrequent for the greater part of the crop to become infested and much ruined for market purposes. Some years no crop appears at all, owing to the beetles destroying the blossoms. This beetle is one of the most regular pests in this fruit, occurring year after year unless remedies are adopted, and unfortunately it has a very wide distribution in Great Britain. It occurs practically all over England, irrespective of soil. It has been particularly abundant on the loams and loamy clays of the London clay in Kent, and I have seen it carrying ruin before it on chalk, red sandstone,



[F. Edenden.]

FIG. 276.—WORKING OF THE RASPBERRY BEETLE (*Byturus tomentosus*).
A, larva entering fruit ; B, core eaten by larva ; C, hole made by larva ; also D.

gault, and brick-earth. It has been inquired about by fruit-growers and gardeners in Cambridgeshire, Worcestershire, Herefordshire, Gloucestershire, Bedfordshire, Surrey, Hampshire, and I have seen it working in Yorkshire and Huntingdonshire to a serious extent. It occurs abundantly in parts of Scotland, and I have already recorded it in raspberries in north Wales (1).

In Europe it is recorded as destructive in France and Germany.

The beetles and larvae are found also on the cultivated and

wild blackberry. In the mature stage it may be found feeding upon apple, pear and hawthorn blossoms.



(Horace Knight.

FIG. 277.—THE RASPBERRY BEETLE (*Byturus tonneatus*).

pubescence, which later becomes of a dull greyish appearance; the underlying colour is dark brown, and the beetle is that colour when old and the pubescence has been rubbed off. The legs are reddish-brown, sometimes with a yellowish hue; the antennæ are yellowish-brown to buff; beneath the elytra are folded two ample wings. They are very active insects, flying from flower to flower with great rapidity in bright weather, but soon become sluggish when it is dull and damp. The earliest date I have of their appearance in numbers is the 2nd of May, when hundreds were seen flying about amongst the raspberry canes at Cambridge in 1890. The majority seem to occur in the first week in June in Kent, and may be found until the end of the month in small numbers, but I have found them at work in the middle of May eating the blossoms, and a few quite early in the month. As soon as the blossoms open the beetles feed on them, and, moreover, they bite off the blossoms and buds just below their base. Whitehead (2) says that they also feed upon the shoots.

When the blossoms commence to open the beetles begin to lay their eggs in them. As a rule a single egg only in each blossom, but

The damage done by these pests is twofold: first, the beetles nip off the blossoms; and, secondly, the larvae eat into and destroy the fruit, or if they do not destroy it, they too often render it unfit for table. Infested fruit, even if it appears sound, soon decays, and a few in a sieve or barrel will wet those surrounding them and soon form a moist squashy mass.

LIFE-HISTORY AND HABITS.

The beetle is $\frac{1}{4}$ inch long, and when young is covered with a dense golden-brown



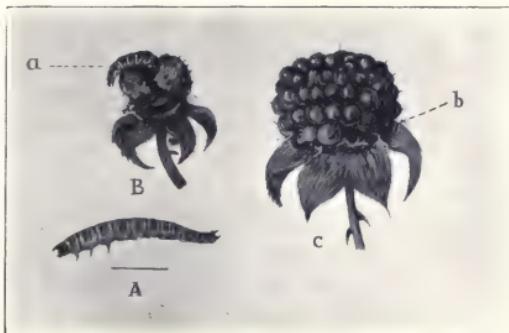
FIG. 278.—RASPBERRY BEETLE.

(Natural size.)

several beetles seemingly attack one blossom, for I have frequently found three larvae in a single fruitlet. The larvae burrow into the receptacle first of all, and as they grow they may attack the developing fruitlets that go to form the berry and so cause deformed raspberries. Sometimes one side of the berry is damaged and aborted, at others the entire fruit is stopped from developing. When the fruit is ripening and they attack it, and they have tunnelled the receptacle, the whole fruit shrivels up and falls. The larva is dull and yellowish, now and again almost white, or grey, with brown markings in the middle of all the segments; the head is brown and flattened and the jaws comparatively strong; on the first three segments are three pairs of jointed legs, and on the anal segment is a more or less pronounced rudimentary leg and two pointed curved spines; the rudimentary proleg is in the form of a cylindrical process on the underside. When full grown they reach $\frac{1}{3}$ inch. On reaching maturity they leave the fruit and crawl about for a little while previous to pupating. They mainly live in tunnels in the receptacle, and feed upon the fruit from the inside where it comes in contact

with the receptacle. It is not at all unusual to see them crawl from one fruit to another, and enter the sound fruit at its base and then the receptacle, into which they at once burrow. Fruit attacked first by the maggots has the hole of the tunnel small at the top and large below; when mature maggots enter the fruit, they seem to crawl up between the receptacle and the fruit, and enter by a large hole which they form at the summit of the receptacle. The larvae pupate in three places, namely, in the soil around the stocks, in crevices in the stakes, and under the rough rind on the canes. The pupae remain all the winter and give rise to the beetles in the following spring in time to attack the blossoms.

Invasion of a plantation may also come in another way, namely, from the progeny derived from those that feed on the wild blackberries.



[F. V. Theobald.]

FIG. 279.—THE RASPBERRY BEETLE (*Byturus tomentosus*).
A, larva (greatly enlarged); B, larva (a) entering receptacle
C, damaged fruit, hole (b) caused by larva.

PREVENTION AND REMEDIES.

It is most essential that all canes cut back or pruned in autumn should be burned, for undoubtedly some of the insects pass the winter under the rind, as well as other pests. As far as possible brambles should be cleaned away from hedges surrounding raspberry plantations, for infestation can clearly originate from that source. This, of course, is not always possible, but if it can be done such a step would be advisable.

It is well, after an attack of the "Raspberry Bug," to carefully hoe soot and lime into the ground near the stock; many of the pupæ are disturbed and their cases are broken, and when this occurs the soot and lime may affect them when in actual contact. Paraffin and ashes hoed in during spring have also been found beneficial. A plantation may be cleared to an appreciable extent by collecting the beetles in May and June, by jarring them off on to tarred sacks or boards held on each side of the canes. This should, of course, be done on a dull, warm day, when the insects are not so active.

In an experiment conducted in 1903 I found that spraying with arsenate of lead killed great numbers of the beetles whilst they were busy biting the buds and blossom heads. This method of checking this serious pest may be worth growers' further attention. Still better results were obtained in 1908 with the formula recommended by Mr. Spencer Pickering and also with Swift's Arsenate of Lead Paste. On the other hand, on two occasions I have known this to fail, so that growers must not place any definite reliance on it, but merely experiment further for themselves.

It has been suggested that vaporite would destroy those in the ground. Even if this proves to be of any value it must not be used on loganberries, for Mr. Geoffrey Hooper of Pershore tells me it is absolutely fatal to the "tips."

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THE RASPBERRY WEEVIL.

(*Otiorhynchus picipes*. Curtis.)

Three weevils of the genus *Otiorhynchus* are enemies of the raspberry grower. This genus of beetles is peculiar in that the species have no wings, and thus are more in our power than most coleoptera. Other features of interest in their economy are that they are mainly nocturnal feeders, and that they all have the habit of feigning death like many other weevils and fall from the trees or plants, upon which they are feeding, at the least shock. All these habits are points we must remember when dealing with the eradication of these very harmful beetles.

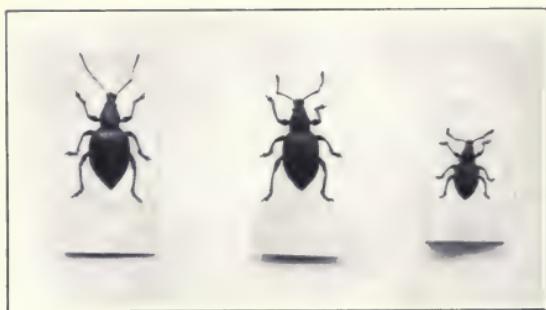
They are not only destructive in the adult condition, but the footless larvae are very harmful to the roots of plants. By far the most important species attacking raspberries is the Raspberry Weevil (*O. picipes*). Various fruit bushes are attacked, and all manner of other plants besides the raspberry. It has occurred damaging hops (1), root crops and pot plants at various times. As a raspberry pest it has been known for many years. Curtis (1836) speaks of its damage to this plant and calls it the "Pitchy-Legged Weevil"; it is also known as the "Night-Feeding Weevil," a name which we may equally well apply to the other two species mentioned here (*O. tenebricosus* and *O. sulcatus*).

The most serious damage done by it has been in Cornwall where, in 1878 (2), many hundred pounds worth of loss took place in the fruit gardens of Madron and Gulval alone. Kent is frequently visited by this pest, especially upon light soil (3). It also often occurs in destructive hordes in Worcestershire, Gloucestershire, and most fruit-growing districts (4). Light, shattery soil seems especially favourable to it, but I have known of many attacks on clay land and on chalk. One important thing has frequently been noticed, namely, that if it occurs in numbers one year it is sure to do so the next, and unless steps are taken may continue from year to year. The damage it does is very varied, by far the worst form of attack is when the beetles eat the fruit blossoms and embryonic fruit buds. At other times they gnaw the rind of the tender shoots, and even nip them right through and eat off the bark of the canes low down. Beetles also eat holes in the leaves, and sometimes completely strip the upper foliage. The early stages of damage to foliage are usually noticed by the leaves being eaten away in small holes. They puncture the tender shoots with their snout, and the punctures let the sap run out for some time; the result is the canes are ruined.

LIFE-HISTORY.

The beetle is oblong, pitchy, clothed with light brown and ashy pubescence, closely covered with brown and pale yellowish-brown scales, which give the elytra a tessellated appearance, with punctate lines or striae, the punctures with scales on each which make them seem ocellated, the rostrum short and spatulate, the thorax granulated (very coarsely in the centre); the legs are red or reddish-brown with black tarsi. There are no wings. In length it varies from $\frac{1}{4}$ to $\frac{1}{3}$ inch.

It appears in May and soon commences its work upon the canes. It remains hidden under clods of earth and under the bottom leaves during the day and only crawls over the plants at night. The habit of falling to the ground at the least jar, noise or light, of a night,



[F. Edenden.]

FIG. 280.—FRUIT TREE OTIORHYNCHI.
1. *Otiorrhynchus tenebricosus*; 2. *O. sulcatus*; 3. *O. leipes*.

is very marked in this species. When the earth is moved during the daytime they roll on to their backs, and owing to the venter being dull earthy coloured it is then extremely difficult to see them, as they remain quite motionless until they think the danger is passed.

At the end of summer the beetles lay their eggs on the ground, and in a week or ten days the larvae hatch out and commence to feed upon the roots of various plants. The grubs are white to dull creamy-yellow, quite footless, curved and with a much wrinkled skin which is slightly hairy, the head is distinct and brown. They remain feeding on roots all the winter and in spring turn to pallid pupae in the soil, from which the adults emerge in May. The larva is rather fat and about $\frac{1}{3}$ inch long. They feed on a variety of plants, not only raspberry and other bush fruit, but various pot plants, hops and innumerable weeds form their bill of fare.

NATURAL ENEMIES.

There are very few natural enemies of this and the two following weevils. But this species is preyed upon by certain hymenoptera of the genus *Cerceris*, black and yellow wasp-like insects. These enemies provision their nests with enormous quantities of this and other weevils for food for their progeny. These false wasps make their nests in the sand banks and pits, loam banks, and gravel pits. Previous to placing the weevils in the nests they sting them and so partly paralyse them, thus keeping them alive, yet inactive, until their larvae are hatched and ready to commence to feed.

Moles are also very fond of the maggots and destroy numbers of them in raspberry and strawberry beds.

Several birds also devour them, such as the Tits (*Paridæ*), Flycatchers (*Muscicapidæ*), and some Warblers (*Sylvinæ*).

PREVENTION AND REMEDIES.

All weeds and rubbish should be kept away from raspberry plantations. After an attack the stocks should be dressed with some quicklime or soot in autumn and well hoed in; another dressing should follow in March, preferably in dry weather, and prong-hoed in round the plants. The beetle may soon be cleared from plantations by jarring the canes over tarred boards held on each side of the canes at night. In doing this one must proceed carefully and not turn the light on to the canes in front, as the least flash of a lantern causes them to fall to the ground, before the men or boys have the tarred boards ready to catch them.

After the gardens have been so treated it is wise to go over them in daytime and prong-hoe round each cane, and at once spread around the cane ash and carbolic. A pint of carbolic to a bushel of ash is usually sufficient. The same will also affect to some extent the larvae, but by far the best remedy for the larvae is the application of bisulphide of carbon, at the rate of $\frac{1}{2}$ ounce to each plant. This should be put in the ground, away from actual contact with any roots, and then close over with earth or clay. It must be used, however, in dry soil, and is best applied in as many small injections as possible, as can easily be done with a Vermorel Injector (p. 152).

One part of naphthalene to ten of fine ash may also be raked into the soil as a means of checking such ground insects.

Recent work has shown that these weevils may be killed by spraying with arsenate of lead.

THE RED-LEGGED WEEVIL.(*Otiorhynchus tenebricosus.* Herbst.)

This large and conspicuous beetle (Fig. 280-1) is found on all fruit trees, and has been reported on raspberries and plums as very injurious (7). It suddenly appears in large numbers. Besides fruit trees it occurs in moss at the roots of grass, according to Canon Fowler (6), who also states that it may often be taken by beating whitethorn hedges. Not only the adults but the larvae also do damage to the raspberry, feeding upon the roots in the stock (7). I have no record of the beetles attacking raspberry outside the county of Kent. In 1899 I found it in numbers amongst the raspberries on Wye College farm, and in a private garden in the neighbourhood, having spread in the latter to the raspberries from some neighbouring plum trees which had been quite defoliated by the beetles. Another year, 1901, I found them attacking the buds early in the year and even biting the shoots and completely destroying the tender leaves. It thus appears that it may at any time attack raspberries as well as plums, peaches, nectarines and apricots. They may frequently be found sheltering at the foot of wooden posts amongst grass and rough herbage. I have also beaten them in numbers from beech trees which they were defoliating near Wye in 1905, and also from hawthorn in the same year. It occurs all over Britain.

LIFE-HISTORY.

The beetle is $\frac{1}{2}$ inch long. In colour it is black and shiny, thorax narrow, rounded, and slightly dilated at the sides; the short blunt rostrum has a ridge in the middle, the long, slender, elbowed antennae are black; the ovate elytra are pointed at the apex, and have in fresh specimens patches of dull ashy pubescence and punctured striae, most easily seen in worn or old specimens, the spaces between are shagreened; the legs are dull reddish, and long: the femora not toothed. The male is narrower than the female, with the anal segment of the abdomen strongly striated. The female has the anal segment of the abdomen punctured, but rather obscurely. The beetles appear in May and June and feed upon the young shoots, buds, and later the leaves of the raspberries. Like the preceding species they are nocturnal, hiding away during the day under clods of earth around the stocks and even under the leaves low down amongst the canes.

They deposit their eggs in the ground in the summer and the

white larvæ, very similar to those of the preceding species only slightly larger, feed during the winter on the tender rootlets of the canes, as well as upon weeds, and other bush and ground fruit. The pupa lies in a case of earth close to the surface of the ground.

The same methods of prevention and treatment apply for this weevil as for the preceding species.

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THE ROSE OR GREEN CHAFER.

(*Cetonia aurata.* Curtis.)

Very frequently we find this common pest attacking and devouring the leaves and blossom of the raspberry and strawberry amongst its host of other food plants. Several cases have been reported of its larvæ killing the canes by devouring the roots of both fruits as well as those of many other plants.

It is not as common as the Cock Chafer, but nevertheless often does much damage. Whitehead (1) records it attacking raspberries, "into whose roots it had made great inroads, causing the plants to flag." On two occasions the larvæ have been sent me from the south of England working in a similar way, and I have personally noticed the beetles feeding on the blossom and leaves in Huntingdonshire and in Kent, and doing far more harm than the Cock Chafers, being very ravenous feeders in bright sunny weather.

This beetle is well known to rose-growers, and its larvæ also do harm in vine borders. It has been recorded attacking and stripping the leaves of currants and beans (2). Blossoms such as pear, apple, privet and turnip are also damaged (1). The larvæ are very powerful and resemble those of the chafers; their mandibles are so strong that they can cut through the thick stems of strawberries and eat away large patches in the roots of vines, apples, damsons and plums. In the case of raspberry attack they cause the whole plant to wilt and the fruit soon falls off.

LIFE-HISTORY AND HABITS.

This beetle is frequently called the Rose Beetle and belongs to the same section as the Chafers, namely, the *Lamellicornia* and to the genus *Cetonia*. It is of a brilliant metallic green colour with golden sheen in sunlight, with more or less distinct white spots on the elytra; the metallic green legs have tibial spines, which are very pronounced and augmented by others on the front legs. The antennæ are provided with three fan-like lamellæ at the apex. The wings are very powerful, so that the beetles are capable of flying some distance and with considerable force. They appear first of all in May, sometimes as early as the first week in the month. Flight only takes place in warm bright weather when they may be seen flying from blossom to blossom. The beetles then feed ravenously,

and go on feeding until the end of June or the middle of July. I have seen some as late as the end of August, but only stragglers. The eggs are laid in the earth from the last week of June until August; they are placed some depth under the soil, the beetles being capable of burrowing into loose earth some distance, making use of the spines on the front legs. The larvæ hatch from the eggs in from twelve to fourteen days and feed upon the roots for two years at least, according to Curtis (3) as much as three years. They resemble the larva of the Cock Chafer, being dull white in colour, much wrinkled, with large brown head, brown

legs on the first three segments, swollen apically and minutely hairy; on the first segment is a distinct brown spot on each side. When full fed they are $1\frac{1}{2}$ inch long. The pupal stage is undergone deep in the soil in an oval case made of earth, stones and debris united by secretions formed by their bodies; the outside of these earthen cells is usually very rough, the inside smooth. The pupa is pallid with dusky eyes and apex, and three more or less dark longitudinal lines on the back and is about $\frac{2}{3}$ inch long. Besides feeding on living roots the larvæ occur in heaps of leaf mould and undoubtedly feed on decaying vegetable matter.

PREVENTION AND REMEDIES.

It is well known that this beautiful beetle seeks shelter beneath which to deposit its eggs, it is thus very important to see that weeds



[F. E.]

FIG. 281.—THE ROSE CHAFER
(*Cetonia aurata*).

are well kept down in the raspberry plantations, and that all manure is well dug into the ground. When dealing with strawberries it is advisable to give up the practice, as far as possible, of putting grass and long manure under the plants, as it is sure to attract the beetles to deposit their eggs.

When raspberry canes are seen to be flagging from some root trouble, the earth should be deeply forked over around the stock, and any larvae turned up picked out and killed. A good drenching after with liquid manure and soot-water will dislodge many of those that remain.

These grubs, which are often found in vine borders, may be caught by placing a turf upside down in the soil. The white grubs go to this and may be hand-picked.

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THE COCK CHAFER.

(*Melolontha vulgaris.* Linn.)

On several occasions complaints have been made of the damage to raspberry, strawberry and other foliage caused by the Cock Chafer (*Melolontha vulgaris*). The adults devour all manner of leafage, but especially the leaves of oak and other trees. The thick growth of the raspberry forms a tempting shelter during the day for these beetles, and no doubt in that way they are first attracted to the canes and, being there, devour the foliage. It is not so much, however, in this way that this beetle is an enemy, but by means of its larvae, the so-called white grubs, which feed upon the roots of the canes and strawberry plants and so weaken them and even kill the plant outright, just as they do to currants and sapling trees. This Cock Chafer is found in most districts, but it is especially in the south, south-west and south-east that it occurs in large numbers. Like its allies, the Northern Chafer, the Summer Chafer and the Garden Chafer, it has definite years of appearance, with intervening periods when we scarcely notice any. During the latter time they are in the larval stage working in the ground. The Cock Chafer years are quadrennial and can be foretold just as regularly as in the case of the Seventeen Year Locust (*Cicada septemdecim*) in America. From

all accounts I can gather it seems that this pest has decidedly increased of late years in Great Britain. It is a general pest, attacking, in its larval stage, all vegetation below ground; the adults are more particular in their food.

LIFE-HISTORY AND HABITS.

The Cock Chafer, also known as the Large Chafer, often reaches 1 inch in length. Its head and thorax are black, the elytra or wing cases reddish-brown,

each elytron with four raised lines running longitudinally, the elytra are hairy and do not entirely cover the abdomen; on each side of the body are alternate black and white patches; the legs are brown and hairy, and the front tibiae have two spines near the apex; the body of the female ends in a horny ovipositor; the antennae end in seven leaf-like lamellæ in the male, six in the female; these plates open and close up like the ribs of a fan.

The Cock Chafer occurs in May and June, mostly early in the latter month. They are extremely sluggish during the day-time, hiding under and amongst dense foliage, often numbers together, holding on rather firmly by their hooked claws. At night they fly about with a heavy, yet powerful flight, producing a loud hum or whirl. The female deposits her eggs in the ground and especially in loose



[F. Edenden.]

FIG. 282.
LARGE CHAFER (*Melolontha vulgaris*).
SUMMER CHAFER (*Rhizotrogus solstitialis*).
GARDEN CHAFER (*Phyllopertha horticola*).

soil. The eggs are often buried 7 or 8 inches deep.

The eggs are large, about the size, and somewhat the shape, of a hemp seed, creamy-white in colour. The grubs are thick, fleshy and white in colour, the tail end is swollen and almost bladder-like and semi-transparent, the black intestinal matter showing through, curved

and with six brown jointed legs in front; the head is large, brown, provided with strong biting jaws. When mature they attain the length of $1\frac{1}{2}$ inch. This stage lasts three years. Although these white grubs are sluggish when removed from the soil, they move with ease when in it, especially if the soil is light and friable. They do not feed at any depth, but, like wireworm, they pass deeper into the soil when the land is frozen. They gnaw the roots, both young and old, and frequently work their way right into the centre of the mass of raspberry roots and remain feeding there until the plant is killed. At the end of their third year, usually in the early spring, sometimes in the preceding autumn, they reach maturity, burrow deep into the earth, make a smooth-lined cell and change into the pupa, which is pale brown in colour.

The larvae of this species may be distinguished from the other two allied pests by the mandibles having a granulated area where the dark and pale parts of the jaws unite. The beetles hatch from the pupae some little time before they appear above ground.

PREVENTION AND TREATMENT.

The beetles may easily be collected in raspberry plantations by beating or shaking them off the canes during the daytime on to tarred boards; great numbers may be collected in this way, just as the Raspberry Weevils are.

The larvae at the roots are more difficult to get at. Hoeing in soot and lime has been said to do good, but it is very uncertain in action.

Vaporite is now well known to destroy these white grubs and may safely be recommended for this purpose.



[F. E.
FIG. 283.—LARVA OF COCK
CHAFER.
(Immature.)

THE SUMMER OR SMALL CHAFAER.

(*Rhizotrogus solstitialis*. Fabr.)

The Summer or Small Chafer in some years and in some districts is more abundant than the Large or Cock Chafer. It likewise damages the foliage of the raspberry and other fruit, and also eats the blossoms.

The beetle (Fig. 282) is variable in size, some being $\frac{2}{3}$ inch long, others slightly less; it is very like the Cock Chafer, but smaller,

and in colour it is of a dull reddish-brown, and slightly hairy. It appears in June and July, and is nocturnal in flight. The larvae are smaller than those of the Cock Chafer and might be mistaken for young of that species, but an examination of the mandibles soon shows the difference. In the Summer Chafer the whole surface of the mandible is very minutely granulated, whereas in the Cock Chafer there is a granulated area only where the light and dark parts of the jaws unite. The larvae live from one to two years, a shorter existence than in the Large Chafer. The beetles may be collected and destroyed in the same manner as the preceding species. It is only an occasional pest in fruit plantations.

THE SNAG BORING EMPHYTUS.

(*Emphytus cinctus*. Linnæus.)

The insects found on the raspberry are very numerous; fortunately, many have not so far occurred in sufficient numbers to have acquired the term of "insect pest," but as is well known they may become so at any time. Hence, any details regarding them may prove of value should they do so. A communication concerning an *Emphytus*, one of the sawflies, was received in February 1906 from near Ledbury.

Mr. Bickham (1) wrote as follows:—"As you will see by cutting open the snags, a caterpillar has bored its way down into the pith. I have found as many as three green ones in one snag, and some I found had spun a cocoon and were turning to chrysalids."

The larvae were received in January, and were kept under observation.

The species was easily identified as *Emphytus cinctus* of Linnæus on its hatching out.

This species normally feeds on the rose, both wild and cultivated, and is now and again troublesome in that respect. I am not aware of its having been found on the raspberry before.

Taschenberg (2) gives an account of it, and refers to it as "Die weissgegürtelte Rosenblattwespe," and figures the larva and adult, but not with sufficient accuracy to enable its identification. Cameron (3) describes it in detail, and states that it is commonly distributed in Britain, especially in gardens.

Mr. Bickham, in writing, did not state that it had done any damage, but being present in considerable numbers in the stubs, it is possible that it may increase to a disastrous extent. The larvae

appear in summer, when attack on the foliage would not matter so much, unless very serious.

It would be well, nevertheless, to take steps to destroy them, even if present in only small numbers, as those that may appear earlier would cause no slight loss.

DESCRIPTION OF THE ADULT.

In length the male and female are much the same, 12 to 14 mm. Cameron (3) gives 4 to $4\frac{1}{2}$ lines (a *line* is equal to $\frac{1}{12}$ inch).



[F. Edenden.

FIG. 284.—THE RASPBERRY SAWFLY (*Emphytus cinctus*).

1, sawflies ; 2, ichneumon parasites ; 3, cocoon of larva.

General colour shiny black; head black, with fuscous grey down; palpi and labrum black, but the latter may be pale grey, and also the apex of the former; the nine-jointed antennae are deep black. Thorax black, with two round yellow to white spots, placed posteriorly.

Abdomen shiny black, a small but distinct pale blotch on the middle of the posterior of the first segment, the fifth segment has a dull white to bright white basal band spreading out at the sides and

passing ventrally; the apex is hairy, curved and projecting. Legs, with the anterior and mid coxae and trochanters black and testaceous; the hind coxae and trochanters yellowish-white; the fore and mid femora are black, except at the apex where they are testaceous or reddish, in the hind femora the base is white; tibiae and tarsi brick-dust red, but the tarsi show fuscous shades, especially apically.

Wings hyaline, with a small pale basal spot; costa reddish-brown to brown; stigma black apically.

The male is much like the female, but has no pale area on the fifth segment, the whole being shiny black; the antennae are very



[F. Edenden.]

FIG. 285.—RASPBERRY SNAGS WITH *Emphytus cinctus* CHAMBERS.

similar but a trifle thicker; the hind femora are entirely dark, and the palpi are quite white apically.

The first adults hatched out on the 21st of May and continued to appear until the 23rd of May.

There are thus evidently two broods, if not more, for they soon commence to deposit eggs which hatch some seven to nine days later.

The eggs are laid, as Cameron (3) describes, on the underside of the leaves in rows.

The larva (Fig. 286), when mature, reaches about $\frac{1}{2}$ inch in length. It is then of a general greenish and pale greyish-green hue. The head is transparent yellowish with a greenish tinge; eyes black; mouth parts dark brown; dorsum deep olive-green, with a pale

dorsal median line; the sides pale greyish-green, commencing just above the dark spiracles; there are two dark patches just above each proleg, the lower the larger, the upper smaller one is anterior; these also occur on the fourth and twelfth segments, but are smaller; legs pale greenish-grey with dark apices; prolegs pale; the last two segments show a yellowish tinge and some minute spines. The skin is much wrinkled (Cameron says: "Beset with small shining white tubercles"). Where the first brood pupates we do not know.

The larvæ occur again in the summer and early autumn (*i.e.*, from the end of July until October).

Those under observation had all pupated, or rather spun up, in the hollows of the raspberry stems that had been cut back. When they attack the rose they usually pupate in the branches. The larvæ spin, in the hollowed-out pith cavity, a semi-transparent parchment-like grey to dull olive-green cocoon in which they remain all the winter. In March or April the larvæ pupate within the cocoon.

The larvæ and adult seem subject to much variation in colour, the latter especially in regard to the legs.

This sawfly occurs in Germany, Austria, Hungary, France, Switzerland, Holland, Sweden, Russia, and Eastern Siberia, and, I believe, Finland.

NATURAL ENEMIES.

A large Ichneumon, *Cryptus emphytorum*, Boie, is parasitic on this insect. An Ichneumon hatched out on the 19th of March from the material sent by Mr. Bickham. Its head, thorax and abdomen are shiny black; the head and pleurae are clothed with pale pubescence; the legs are deep brick-red; the antennæ black with a median creamy-yellow band; the hyaline wings have a deep brown stigma and a small creamy-white spot at the base.

Should this turn out to be a harmful insect in Herefordshire, it could easily be controlled by heavy spraying with hellebore wash or arsenate of lead to kill the last brood in the autumn. Those that occur in the spring, if this were done, would do but little damage, as they would be few in number. It would be well, however, to destroy any that are seen then as well.

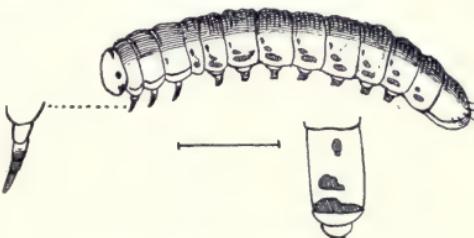


FIG. 286.—LARVA OF *Emphytus cinctus*.

The SYNONYMY of this species is as follows :—

Tenthredo cincta, Lin., S.N. ii. 925.

Tenthredo togata, Zell., Ins. Lapp., 342, 16.

Emphytus cinctus, Klug, Berl. Mag., 279; Ste., Ill., vii. 89, 4; Htg., Blattw., 248, 3; Bouché, Naturg., 139 (lar); Westwood, Gard. Chronicle, 1856, 25, 421; Vollenhoven Tidj. Ent., viii., 73–77, pl. 3. (lar. im., etc.); Thoms., Op., 274, 6; Hym., Sc., I., 189, 2; Kalt., Pfl., 222; Briske, Beschr., 16, pl. iii., fig. 6; Evers., Bull, Mosc., xx. 26, 2; Cam., Fauna, 20, 1; André, Species, 1, 251; Cat., 31, 17; Kalt., Prk. Insk. Kund., p. 329; Cameron, Mono. Ph. Hy. Ray Soc., 1. p. 269.

Dolerus cinctus, Lep., Mon., 117, 342.

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- (1) *Theobald, F. V.* Report on Economic Zoology for the year ending April 1st, 1906, p. 54 (1906).
- (2) *Taschenberg.* ‘Praktische Insekten-kunde,’ I., p. 329 (1879).
- (3) *Cameron, P.* ‘Monograph of British Phytophagous Hymenoptera,’ I., p. 269 (1882).

OTHER SAWFLIES (*Tenthredinidae*) FOUND ON RASPBERRIES.

Five species of sawflies may be found now and again on the raspberry, but none have so far done any harm. They are, *Nematus pallidiventris*, Fallen; *Emphytus rufocinctus*, Retz.; *Emphytus perla*, Klug.; *Cladius brullaei*, Dbm.; and *Fenusaa pumila*, Kl.

The larva of *N. pallidiventris*, Fallen, is green and much wrinkled, with a dark green median line with an almost white line on each side; head brown; eyes black and with three rows of hairs on each segment. It is found in May and June on various plants, notably *Geum*. Buckton records it from Gloucester and Clydesdale. The thorax is black, yellowish at the sides; the abdomen yellowish-brown with black bands; antennae black, legs yellowish-brown, the apex of the hind tibiae and the mid and hind tarsi black. Length 6·5 mm. The larva of *E. rufocinctus* is white with a dull grey back, and feeds in August and September and also occurs on roses. That of *E. perla* is olive, whitish at the sides, and occurs in June and July. *Cladius brullaei* is found in spring, and its larvæ have been found on the raspberry a few times in June and July; they are brown and white with a black head. *Fenusaa pumila* now and again is seen mining the leaves of the raspberry from July to October, but chiefly occurs on brambles. (Reports on Economic Zoology, Journal S. E. Agri. Coll., No. 13. June 1904. F.V.T.)

THE RASPBERRY GALL FLY.

(*Lasioptera rubi*. Schrk.)

This fly is one of the gall midges or *Cecidomyidae*. It has seldom been brought to my notice as occurring in any amount on raspberries (1), and can scarcely be looked upon as a pest. It frequently may be met with on brambles in hedgerows.

Ormerod (2) refers to what is evidently this insect. Specimens were sent her from Kent by W. C. Whitehead in 1884.

The galls contain eight to ten orange coloured larvæ in the black, rotten interior. The galls are situated on all parts of the cane; the largest measure 1 inch across and have thick walls. The damage noticed in 1898 was very apparent, several attacked canes showed very few leaves and no fruit. It was observed on brambles in the neighbourhood in small numbers. The larvæ are full grown by April and are bright orange in colour. Length $\frac{1}{10}$ inch. They pupate in the galls by the first week in May. The flies hatch out in June, and some at the end of May. The female lays eight to twelve eggs at the base of the buds and side shoots during June. These hatch in eight days.

The young larvæ burrow into the rind, and by six weeks a distinct gall is formed and in these the larvæ remain and pupate in the spring, from March to May. The galls are closed, the flies escaping from cracks or decayed parts. All galls when first seen should be cut off and burned, as this fly has been increasing materially in Kent during the last few years.

Kaltenbach considered the flies reared from such galls by himself to be *Lasioptera argyrostictar*, Meigen. But this species is the same as *L. rubi*.



[W. H. Hammond.]

FIG. 287.—GALLS OF *Lasioptera rubi*.

REFERENCES.

- (1) *Theobald, F. V.* Journal South Eastern Agri. Coll., No. 7, p. 15 (1898).
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- (3) *Theobald, F. V.* 'An Account of British Flies,' vol. I., p. 88 (1892).

THE RASPBERRY APHIDES.

(*Siphonophora rubi*, Kalt., and *S. chelidonii*, Kalt.)

Two species of aphides frequently occur on the raspberry. In no case have I heard or seen any appreciable damage done by these insects. They can easily be checked should they increase in large numbers by spraying with quassia and soft soap.

The Raspberry Aphis.

(*Siphonophora rubi*. Kalt.)

By far the commoner of the two is *Siphonophora rubi* of Kaltenbach, which is sometimes quite numerous in May and June on the under surface of the leaves of both the wild (*Rubus idaeus*) and cultivated raspberries. To some extent they curl up the leaves, but never to such an extent as to do any appreciable damage. Nevertheless they may at any time increase to such an extent that they become destructive. This insect occurs in Kent, Gloucestershire, Devon, Surrey and Worcestershire.

LIFE-HISTORY.

The apterous viviparous female is $\frac{1}{4}$ inch long; oval, shining green and hairy, with red eyes; long curved cornicles, dilated at their bases, their middle and apices. The legs are green, except for the black tarsi. They may be found on the raspberry in May and June and seem to reproduce but slowly. I have found them in the curled apical leaves and on the lower leaves as well. This form also occurs on the blackberry, and according to Buckton (1) later in the year on broom.

The pupa is much like the above, but I have noticed a darkening at the tip of the cornicles. Winged viviparous females occur now and again in summer. In colour they are entirely green, with red eyes and ocelli, slightly hairy, and with long antennæ and legs. They are quite active on the wing on warm bright days, and soon commence to produce living young, but this they do slowly. One kept under observation gave rise to four in a week. They breed

late into the year and I feel sure there is an active migration to other plants, probably to the broom in the latter part of the summer.

In the autumn we find them again on the raspberries, and males and oviparous females are then produced.

The oviparous female is wingless and oval, green, and with long antennæ and legs. Now and again reddish specimens may be found, these are few in number. They may be found as late as November on the raspberries. The male is winged, green, with a black head and the thorax with black lobes; the abdomen very small, legs very long and wings very large. They may be found on the plants with the wingless females right into November.

The eggs are laid on and under the rind of canes and on brambles, and are shiny black and of typical aphid form.

It is a widely distributed insect, and undoubtedly invades the raspberry from the bramble (*Rubus fruticosus*).

The Allied Raspberry Aphid.

(*Siphonophora chelidonii*. Kalt.)

Buckton (1) records this species also on the raspberry, feeding sparsely under the leaves from the month of May to October. I have failed so far to find it in Kent, but have noticed it once in Surrey.

The apterous female is much like the preceding, but of a duller and browner green, and the legs and antennæ are not so long. The winged viviparous female is bright green, with the thoracic lobes and scutellum olive; antennæ brown, the third segment tuberculate; cornicles long, thin, and brown; legs yellowish-green, with the apices of the femora and the tarsi deep brown. Length of body a little more than $\frac{1}{2}$ inch.

TREATMENT.

Whenever these aphides occur in numbers they can soon be cleared off by washing with quassia and soft soap. All prunings should be burned in winter and thus many eggs are destroyed.

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- (2) *Theobald, F. V.* Journal South Eastern Agricultural College, No. 13, p. 147 (1904).

STRAWBERRY.

INSECTS, ETC., INJURIOUS TO THE STRAWBERRY.

LEPIDOPTERA.

- GARDEN SWIFT MOTH (*Hepialus lupulinus*. Linn.). Roots, p. 446.
 HEART AND DART MOTH (*Agrotis exclamacionis*) and YELLOW UNDER-WING (*Triphaena pronuba*). Roots and Runners, p. 450.
 STRAWBERRY LEAF BUTTON MOTH (*Peronea comariana*. Zell.). Leaf and Blossom, p. 453.
 THE LARGE WHITE PLUME MOTH (*Aciptilia pentadactyla*. Linn.). p. 455.

COLEOPTERA.

- ROSE CHAFER (*Cetonia aurata*. Linn.). Roots and Leaves, p. 429.
 COCK CHAFER (*Melolontha vulgaris*. Fab.). Roots and Foliage, p. 481.
 GROUND BEETLE (*Calathus cistelooides*. Panz.).
 " " (*Harpalus ruficornis*. Fab.). } Fruit and Roots,
 " " (*Pterostichus vulgaris*. Linn.). } p. 455.
 " " (*Steropus madidus*. Fab.).
 STRAWBERRY LEAF BEETLE (*Galerucella tenella*. Linn.). Foliage, p. 459.
 RASPBERRY WEEVIL (*Otiorrhynchus picipes*. Fab.). Foliage, p. 425.
 STRAWBERRY WEEVIL (*O. sulcatus*. Fab.). Foliage and Roots, p. 460.
 RED-LEGGED WEEVIL (*O. tenebricosus*. Linn.). Foliage and Roots, p. 426.
 STRAWBERRY AND RASPBERRY ANTHONOMUS (*Anthonomus rubi*. Herbst.).
 Blossoms, etc., p. 461.
 SMALL STRAWBERRY FRUIT WEEVIL (*Exomias araneiformis*. Schrank).
 Fruit, p. 462.
 MINUTE RHYNCHITES (*Rhynchites minutus*. Herbst.). Foliage, p. 464.
 STRAWBERRY CLICK BEETLE (*Adrastus limbatus*. Fab.). Roots, p. 464.

HEMIPTERA.

- THE STRAWBERRY APHIS (*Siphonophora fragariella*. Theob.). Foliage and Trusses, p. 465.
 WILD STRAWBERRY APHIS (*S. fragariae*. Koch). Foliage, p. 467.

VERMES.

- STRAWBERRY EELWORM (*Aphelenchus fragariae*. Ritz. Bos.). Whole Plant, p. 472.
 ROOT EELWORM (*Tylenchus devastatrix*. Kuhn.). Roots, p. 474.

MOLLUSCA.

- STRAWBERRY SNAIL (*Helix rufescens*. Penn.). Foliage and Fruit, p. 469.
 SLUGS (*Limacidae*). Fruit, etc., p. 470.

THE GARDEN SWIFT MOTH.

(*Hepialus lupulinus*. Linn.)

Great damage is often done to the roots and stocks of plants and also to bulbs and corms by the caterpillars of the common Garden Swift Moth.

As a fruit pest it is mainly the strawberry that suffers from its ravages. From 1894 to 1897 there was a great increase of this



FIG. 288.—GARDEN SWIFT MOTH.

insect in many parts of the southern, midland and eastern counties (1). This appears to have been due more to a change of habits than to any great increase in the number of moths, for it has always been a very common species. Curtis (2) called attention to the damage caused by the larvae as far back as 1845. Ormerod (3) and Whitehead (4) refer to this insect as destructive, but the former states



FIG. 289.—PIECE OF STRAWBERRY STOCK EATEN INTO BY GARDEN SWIFT MOTH CATERPILLAR.

(5) that she had "only once received communication of a really serious attack attributable to this caterpillar."

The family *Hepialidae*, to which the Garden Swift belongs, consists of a single genus only, namely, *Hepialus*.

Another species, the Ghost Moth (*Hepialus humuli*), does some harm to the hops, but the other three British species are of no economic importance at present.

The larvae of the Garden Swift are especially harmful in warm winters, when they can work continuously underground unmolested

by the cold, which only seems to drive them deep into the soil. Nearly every kind of plant is attacked by them (1).

In 1896 damage caused by them to strawberries was reported from Canterbury. In 1905 they were reported by Mr. Champion as doing much damage to the same plants near Maidstone and also again near Canterbury. In 1907 they were said by a correspondent to be very plentiful in strawberry beds at Warlingham. They attack this fruit plant, first of all, by eating the rootlets, and later they tunnel right up the main roots (Fig. 289) and even into the crown. By so doing they entirely destroy the plants.

LIFE-HISTORY.

The adult moth appears about mid May and continues throughout June, and may even be found as late as mid July.

The moth appears on the wing at dusk, especially over grass, clover and herbs, and flies with a curious, pendulum-like movement, especially the male. It darts about with great energy, hence the name Swift Moth.

The moth (Fig. 288) is very variable in size and colour. The



[F. Edenden.

FIG. 290.—LARVÆ OF GARDEN SWIFT MOTH.

(Slightly enlarged.)

length is about $\frac{1}{2}$ inch, and the wing expanse from 1 to $1\frac{1}{4}$ inch. The fore wings are pale fulvous brown, with a pale almost white streak running from the base to the inner margin, and this is continued from the inner margin to near the apex; hind wings pale brown; abdomen yellowish-brown. In some the white on the wings is almost absent.

The ova are dark coloured and are dropped by the females during flight upon the ground and may hatch in nine days. The

larvae (Fig. 290) coming from them at once enter the soil and commence to feed upon the roots of the plants. They may be found from mid June right through the winter to April. In size they are fairly uniform, when mature being nearly $1\frac{1}{2}$ inch long, when expanded. The colour is dull white to creamy-white, somewhat shiny, the head chestnut-brown, mandibles dark; the first segment is white, but, owing to the head being partly withdrawn into it at times, assumes a brown colour; the spiracles are dark with a pale border; each



FIG. 291.—PUPA OF GARDEN SWIFT MOTH.

segment has four hairs upon its dorsum, the two lower ones being the larger, arising from dark dots, and there are four other hairs on the sides of each segment; their legs are normal. When touched they wriggle backwards with great energy. Greenish tinged specimens may occur (1), but not in the roots of strawberries.

The pupæ are found in the ground in May. They are brown to chestnut-brown in colour, cylindrical, with deeply constricted abdominal segments, especially ventrally, five of the abdominal segments are armed with rows of spines, on ridges, on the dorsum, four have rows of ventral projections, and the last segment is prominently ridged, the caudal extremity has two diverging wart-like processes and a few hairs or bristles. The segments are freely movable. In length the pupæ reach a little over $\frac{2}{3}$ inch. They are found some little distance below the ground in a pale loose silken cocoon, or may be nude.



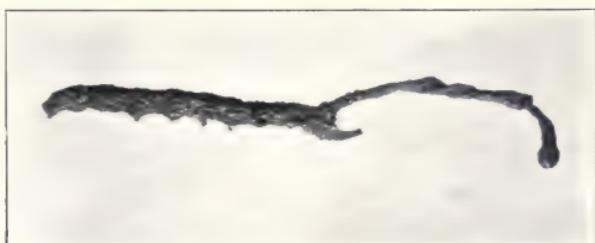
FIG. 292.—EARTHEN COCOON AND EMPTY PUPA SKIN OF GARDEN SWIFT MOTH.
[F. Edenden.]

NATURAL ENEMIES.

The only insect enemy of the larvae seems to be a species of bug, an *Anthocoris* (6), which sucks the juices of the larvae and soon causes their death. Their method of procedure is to crawl upon the

back of the larva and then plunge their beaks into them just behind the head ; soon after this the larva sickens and dies.

This predaceous enemy was sent me in 1896 from Canterbury and from Kimbolton in Huntingdonshire. A fungus, known as *Cordyceps entomorrhiza*, has been found invading these larvae (1) near Maidstone and also at Wye. This parasitic fungus completely invades the larvae and replaces every part of their body. They may frequently be found covered with a coarse white mycelium, forming



[F. Edenden.

FIG. 293.—LARVA OF GARDEN SWIFT MOTH ATTACKED BY A FUNGUS
Cordyceps entomorrhiza.

a mossy-like growth. Later, a curious large fruit-bearing body (Fig. 293) about 1 inch long makes its appearance and grows up into the air. This peculiar growth is reddish-brown in colour, darkened towards the tip, and from this body "spores" are passed out over the soil and thus fresh larvae are affected. These so-called "Vegetable Caterpillars" have also been found at Hitchin by Cook (7). The Swifts or Hepialidae are particularly liable to be invaded by this and other *Cordyceps*.

PREVENTION AND REMEDIES.

A good deal of good may be done in an infested bed by constant hoeing ; numbers of the whitish larvae will then be destroyed.

This should be followed by a top dressing of some noxious substance, and for this soot has been found excellent if worked into the soil around the plants. At other times it completely fails.

Kainit and muriate of potash have both been used with beneficial results, wood ashes have also been found deleterious to them. The best results I have had have been with gas lime and vaporite. This is one of those attacks that can only be checked with patient work, for it seems that if left alone it may recur year after year.

We can do nothing to prevent the moths from laying their eggs,

but as we know the ill effect of certain dressings on the young larvæ it is well to prevent the damage by employing one of them in early autumn.

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- (3) *Ormerod, E. A.* Twentieth Report on Injurious Insects, p. 41 (1897).
- (4) *Whitehead, Sir C.* Journal of the Board of Agriculture, vol. III., p. 36.
- (5) *Ormerod, E. A.* 'Manual of Injurious Insects,' (2nd Ed.), p. 9 (1890).
- (6) *Theobald, F. V.* 'The Entomologist,' p. 194 (1896).
- (7) *Cook, M. C.* 'Vegetable Wasps and Plant Worms,' p. 165 (1892).

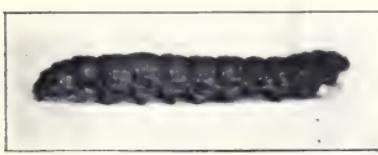
THE HEART AND DART MOTH.

(*Agrotis exclamacionis*. Linn.)

AND THE YELLOW UNDERWING.

(*Triphana pronuba*. Linn.)

The caterpillars of the Heart and Dart Moth now and then are recorded as damaging the rootlets and runners of strawberries, and have also been found eating the "tips" of loganberries.



(F. Edenden.

FIG. 294.—LARVA OF HEART AND DART MOTH
(*Agrotis exclamacionis*).

a similar manner, but the only other one sent me has been the large larva of the common Yellow Underwing (*Triphana pronuba*, Linn.), and this only on two occasions.

LIFE-HISTORY AND HABITS.

The Heart and Dart Moth appears in June and July. The moth (Fig. 295) is brownish to almost clay coloured, the fore wings with darker markings, one being almost kidney shaped, one dagger shaped and darkened towards the edges; the under wings of the male are almost pearly white, of the female, brown. The natural size is seen in the photograph (Fig. 295). The eggs (Fig. 296) are laid at dusk on plants close to the ground and even on objects on the ground. The

moths are nocturnal and are very fond of sweet substances. Great numbers may be taken by placing sugar or treacle and rum on the trunks of trees.

The caterpillars feed at night; when quite young they may be found during the day under leaves close to or on the ground. As they grow they take to the soil, or hide under tiles and stones and crawl forth at night to feast on the leaves near them; at the same time they feed on the roots, frequently cutting them asunder, hence they are called "cutworms." They also cut off leaves and pull them into the ground to serve as food. The size attained at maturity is $1\frac{1}{2}$ inch. The colour is dull brownish to greenish-lilac, with a pale dull ochreous hue down the centre, with one dark line along each edge and a double one along the centre of the back; the head is brown, and the first segment of the body dark, and all the segments have four small tubercles on the top, with a delicate hair projecting from each and others on the sides; the ventral surface is pale dull green. As in all true caterpillars, there are three pairs of jointed limbs on the first three segments, then two without any, then four pairs of fleshy prolegs, and an anal pair. They live and feed right through the winter and pupate in late April on to mid May. In habits they are very sluggish, and often assume a fattened appearance, as thick as a goose quill. They enter the pupal stage in a cell in the earth, the pupa being brown and smooth skinned. The Yellow Underwing (Fig. 297) can at once be told by its yellowish posterior wings, with a dark line near the edge. It appears in June, July and August also, and has similar habits. The caterpillar is dull yellowish to greyish or brownish-green, with a pale line along the back, and a similar one on the sides below the latter, with some large dark spots above on the third to eleventh segments, and there is an indistinct side line.



[E. Tonge.
FIG. 295.—HEART AND DART MOTHS,
SHOWING VARIATION.]

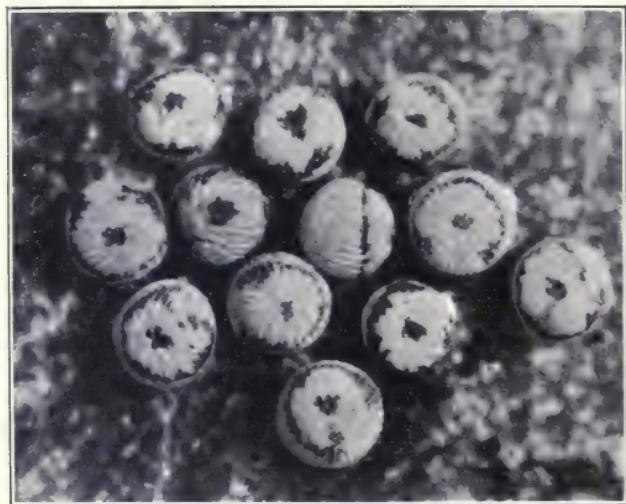


FIG. 296.—EGGS OF HEART AND DART MOTH. ($\times 20$). [E. Tonge.]

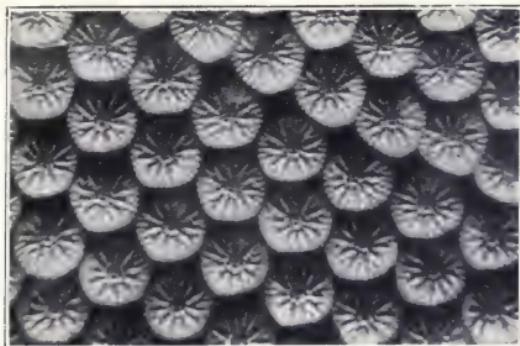


FIG. 297.—YELLOW UNDERWING MOTHS, SHOWING VARIATION IN COLOUR.

PREVENTION AND TREATMENT.

It is impossible to prevent the appearance of these larvae, as the moths are winged and fly some little distance. They may, however, be trapped in two ways: one, by placing sods of grass upside down on the ground near the strawberry plants and having those that collect underneath killed; or by spreading small heaps of bran or clover poisoned with arsenate of lead or Paris green about the beds in spring or autumn, the larvae at night are attracted to these and are poisoned. Frequent hand-hoeing also turns them up, when they may be picked up and

killed; and all brown pupæ turned up in digging should be crushed. Vaporite has been found effectual in killing these larvæ. Soot and lime seem to be quite useless. Where strawberries or loganberries are seen to be failing, the earth should be scraped away just around them, and the culprits can easily be seen if they are cutworms and destroyed.



[E. Tonge.

FIG. 298.—EGGS OF THE YELLOW UNDERWING. ($\times 20$.)

THE STRAWBERRY LEAF BUTTON MOTH.

(*Peronea comariana*. Zeller.)

A single instance only has been recorded of this *Tortrix* doing any damage to cultivated strawberries. The record is given by Ormerod (1) as follows:—"The following observations refer to the attacks of a small moth caterpillar which some years ago did much mischief to strawberry leafage in the neighbourhood of Dee Banks, Chester. The notes were kindly forwarded to me by Dr. Ellis of Liverpool, to whom they had been communicated by Mr. Richard A. Wrench of Dee Banks. They are as follows:—"I enclose specimens of a grub which infests the strawberries about here and does a great deal of harm; the bulk of the strawberries for Liverpool market are from here. I may say it usually makes its appearance about the beginning of May and lasts until about the end of August, when it goes away.

" Young plants of twelve months old are never affected, two year old plants are affected rather badly, but three year are invariably ruined. I have two fields adjoining one another, the old field utterly

ruined by the grub, the next, only separated by a hedge, is perfectly clean, but next year when it is two years old it is sure to be full of blight."

Ormerod seemed uncertain as to its name, as to whether it was the *comariana* of Zeller or the *comparana* of Hubner. The excellent figure she reproduces from the drawing of Dr. Ellis shows at once



[*Horace Knight.*

FIG. 200.—THE STRAWBERRY LEAF BUTTON MOTH
(*Peronea comariana*).

that it is Zeller's species. This moth, which is referred to by Morris (2) as *Peronea potentillana*, is recorded from Liverpool and Manchester as feeding on the strawberry, the perfect insect appearing in June and September.

The fore wings of the moth are pale ochreous to ochreous-brown, and near the middle of the costa is a dark brown triangular patch, which sometimes continues nearly to the inner margin; the hind wings are uniformly grey. Length of expanded wings about $\frac{1}{2}$ inch. The moths apparently hibernate, for I have taken them by beating in late October in a worn condition at Buxton and again in the early spring at Wye. The caterpillar is green, darker above than below, with a shiny yellow head with dark markings, and of a general shiny appearance.

Dr. Ellis describes a dark well-marked dorsal vessel, this was not very noticeable in some larvae I found on wild strawberries in Derbyshire. They feed on the leaves and calyx, drawing leaves and flowers together for this purpose, and feed also on the receptacle.

The pupa is pale green with reddish wing cases and abdominal segments. At Chester they were found feeding in May and the early part of June (Ellis).

There appear to be two broods during the year, the second appearing in September and October.

REFERENCES.

- (1) *Ormerod, E. A.* 'Handbook of Insects Injurious to Orchard and Bush Fruits,' p. 258 (1898).
- (2) *Morris, F. O.* 'A Natural History of British Moths,' vol. III., p. 137 (1872).

THE LARGE WHITE PLUME MOTH.

(*Acipitilia pentadaactyla.* Linn.)

Collinge (1) records the larvae of this Plume Moth, under the name of the Strawberry Plume, as doing damage to strawberry plants, and says that in the early part of the summer in 1905 they were unusually numerous in Worcestershire, Warwickshire and Staffordshire.

Its normal food plant is the bindweed (*Convolvulus arvensis*), and it is thus strange to find it on the strawberry. It may frequently be seen in numbers in strawberry beds, but it is feeding on bindweed growing with the plants. The moth is common over England and Wales, and appears in June and July; it is snowy white, with five distinct feather-like rays for wings on each side. The upper wings are very scantily dusted with pale grey. The caterpillar is rather hairy, greenish tinged with white, a green line along the back and a distinct black spot on each segment, which are also noticeable in the pupa.

The pupa is found attached by its tail end to the leaf and is slightly hairy.

The larva occurs in May, and sometimes as late as the 3rd of June in Kent, where it occurs on the bindweed but not on the strawberry.

REFERENCE.

- (1) *Collinge, W. E.* Report on Injurious Insects and Other Animals observed in the Midlands during 1905, p. 36 (1906).

STRAWBERRY GROUND BEETLES.

(*Harpalus ruficornis*, Fab., etc.)

In 1894 both Ormerod (1) and Warburton (2) investigated an attack of Ground Beetles or Carabidae on strawberries at Woodborough in Nottinghamshire, and in the following year the attack was renewed. Valuable information has been given us by Warburton in his report (2).

Since then similar damage has been reported to me from Norfolk (3) and Worcestershire (4). Ormerod also records the damage from Herefordshire, Bedfordshire, Gloucestershire and Berkshire (1).

The majority of "ground beetles" or Carabidae are beneficial, for they feed upon slugs, caterpillars, etc., in the soil, and at first some doubt was expressed as to these insects being the cause of the damage. That they are so is now beyond doubt.

A popular name given to them in some localities is that of Bat Beetles. At least four species seem to have acquired the bad habits recorded here, but the one mentioned in the heading is usually the most harmful.

The damage is done to the green and ripening fruit. The beetles eat the skin of the green fruit, leaving many of the seeds; but when the fruit is ripening I have noticed that they especially feed on the seeds, which may be seen lying thick under the plants. The attacked green fruit of course is ruined, withering up, and the ripe fruit is also spoiled, even if only a small surface is damaged. It is not so much the amount eaten as the quantity of fruit that the beetles spoil that makes this attack so serious. On one occasion an attack was watched personally, and the beetles were found eating quite large irregular masses out of the fruit, damage which the gardener had put down to the birds.

SPECIES OF BEETLES FOUND.

The four kinds of beetles which cause this annoyance are known as *Harpalus ruficornis*, Fab., *Pterostichus vulgaris*, Linn., *Steropus*



FIG. 303.—STRAWBERRY GROUND BEETLES.

1, *Pterostichus vulgaris*; 2, *Harpalus ruficornis*; 3, *Calathus cisteloides*.

mudidus, Fab., and *Calathus cisteloides*, Panzer. They may be distinguished by the following characters:—

Harpalus ruficornis.—Black, with red antennæ and legs; length about $\frac{1}{2}$ inch; the wing cases have faint striæ upon them, and are covered with fine golden-grey pubescence; the wings are fully developed.

Stropus madidus.—Black, the legs with more or less distinct reddish bases; length rather more than $\frac{1}{2}$ inch to nearly $\frac{3}{4}$ inch. Wing cases finely striated, but there are no wings. The thorax is narrowed behind, being much narrower than the elytra.

Pterostichus vulgaris.—Black and shiny, legs black. Wing cases with prominent striation, no wings. Thorax broad with a median suture. Length nearly $\frac{3}{8}$ inch.

Calathus cisteloides.—Black antennæ and rusty-red legs. Length $\frac{1}{4}$ inch to nearly $\frac{1}{2}$ inch. Wings absent or rudimentary.

The above-mentioned characters will easily enable the observer to separate these four kinds, which may occur in the strawberry beds.

LIFE-HISTORY AND HABITS.

The beetles all have very similar habits. They are nocturnal and crawl about on the ground with great rapidity; in fact, we may say that they run. The red-legged Harpalus also flies. It appears that this species migrates in large numbers, for Ormerod (1) records them as appearing in a swarm at Bone Hill, St. Albans, and as falling by scores from the walls of a house at Sandridge, having apparently come in contact with them during their flight.

During the daytime the beetles hide under clods of earth, in cracks in the soil, and even actually in the ground, where they form runs opening to the surface by a round hole much like an earthworm's opening. Warburton says: "In the infested beds it was found that the earth, together with the straw and litter with which it was strewn, was perforated in all directions by the 'runs' of the beetles, which were present in vast numbers." The straw between the plants also serves as a nice protection for them.

The beetles may be found in May, but the majority are noticeable in June and July.

They lay their eggs in the soil and the active larvæ feed upon and in it. Their food consists of slugs, earthworms, small snails and insects.

The general appearance is repulsive, their heads rather large and the jaws prominent; the body is elongated, and in their later



[F. E.

FIG. 301.—A CARABID LARVA.

stages the segments are protected dorsally by rather hardened shields, on the first three segments are six jointed-legs, and on the anal segment two pointed horn-like processes, and below a somewhat tubular and extensible single fleshy protuberance like a proleg. The larvæ have not been known to do any harm, but appear on the other hand to be beneficial. Similar damage is done in America by allied species (5).

At one time this attack was thought to be due to some special circumstances (2) or change of habit, and to be new (1).

From inquiries made it seems that gardeners have noticed these insect depredations for many years. That it was not called attention to before is not surprising. As the Nottingham attack was very severe, it was investigated and the real culprits found. Frequent attacks, before and since, to my knowledge have been put down to birds.

PREVENTION AND REMEDIES.

Some good may possibly be done by driving away the larvæ in the soil and so prevent the future beetles from carrying on their ravages. A good dressing of soot well prong-hoed in, in early spring, is best for this purpose.

A mechanical mixture of naphthalene (one part) and road dust or ash (ten parts) has also been found useful in driving the larvæ elsewhere. The beetles may easily be trapped. The best plan seems to be that used by Messrs. Laxton Brothers of Bedford, namely, sinking every here and there jam pots in which pieces of lights or meat have been placed, together with sugar water. These pots (old jam pots I find do excellently) should have the tops level with the ground and be covered over with the straw. The beetles are attracted and fall into the pots, and in this way a bed may soon be cleared of these enemies.

Warburton (2) tells us that at Nottingham large numbers of the beetles were trapped in this way; also that raw meat covered with sacking was used as a bait, and the beetles attracted to it were readily caught and destroyed.

NATURAL ENEMIES.

Moles feed on these beetles and their larvæ, and undoubtedly do much to keep any excess of them in check. The great abundance of these insects in Nottinghamshire was generally attributed to the use of large quantities of town manure and the almost total absence of moles, which had been nearly exterminated in the district during the preceding three or four years.

It was found that the neighbourhood of the solitary mole run which could be found in the infested area was practically free from injury (Warburton).

REFERENCES.

- (1) Ormerod, E. A. 'Handbook of Insects Injurious to Orchard and Bush Fruits,' p. 233 (1898).
- (2) Warburton, Cecil. Annual Report for 1895 of the Zoologist. Journ. Roy. Agri. Soc. of England, vol. VI., pt. IV., 3rd Se. (1895).
- (3) Theobald, F. V. First Report on Economic Zoology (British Museum), p. 19 (1903).
- (4) Theobald, F. V. Report on the Orchards and Fruit Plantations of Worcestershire (Worcestershire County Council), p. 15 (1906).

THE STRAWBERRY LEAF BEETLE.

(*Galerucella tenella*. Linn.)

This again, like the Leaf Moth, has only been once recorded as doing any harm. Ormerod (1) received information of the damage done by it from Hundred Acres, Wickham, Hampshire, with a note that they were destroying the strawberry plants in the neighbourhood, and that it was considered a new pest in the locality.

This beetle is fairly common in this country on willows, alders, etc. In Germany Kaltenbach (2) records it from the Meadow Sweet (*Spiraea ulmaria*) and the Silver Weed (*Potentilla anserina*). The beetles of this genus, several of which are harmful to forest trees, feed in both larval and adult stages upon the leaves. There they do damage in two ways. The larvae eat the lower or upper skin and soft underlying tissues, leaving the epidermis below them intact, like the pear slugworm; the leaves then present a curious spotted appearance. The adults eat out irregular holes right through the leaves.

The beetles and larvae may be found together in July. The former are about $\frac{1}{8}$ inch long, dull yellow to pale brownish; the head is yellow with a broad black stripe across it; the thorax is yellowish with a dark central furrow and a small round depression on each side



[H. Knight.
FIG. 302.—STRAWBERRY LEAF BEETLE
(*Galerucella tenella*).

of it; the elytra are granulated and shiny, with the margin and the suture yellow and a dark spot on the shoulders; legs pale; antennæ long and dark at the apex. The series in the British Museum shows some variation in regards to markings.

The larvæ have not been described, but they are probably like others of this genus, which have six jointed-legs in front and a projection at the tail end and many tubercles.

They live in colonies, and when mature fall to the ground to pupate. Two broods at least occur during the year.

The only *treatment* which suggests itself is spraying the plants with arsenate of lead as soon as the fruit is gathered, and some treatment of the soil to destroy the pupæ in the ground.

REFERENCES.

- (1) Ormerod, E. A. 'Handbook of Insects Injurious to Orchard and Bush Fruits,' p. 249 (1898).
- (2) Kaltenbach, T. H. 'Die Pflanzenfeinde aus der Klasse Insekten,' pp. 220 and 242 (1874).

THE STRAWBERRY WEEVIL.

(Otiorhynchus sulcatus. Fab.)

The strawberry sometimes suffers from this weevil in addition to the Red-legged Weevil (p. 428).

It damages the plants mainly when in the grub stage, the larvæ feeding upon the roots. The beetles also feed upon the leaves and buds. Vines, raspberries, peaches, and many pot plants are attacked by it.

Amongst other names it is called the Black Vine Weevil. It seems to be more harmful under glass in this country than in the open.

The weevil, like the other *Otiorhynchus* mentioned, is wingless and about $\frac{1}{3}$ inch long. In colour it is nearly black; the thorax is granulated, and the elytra are rough with several raised lines and with scanty pale hair tufts; the short rostrum has a distinct groove or sulcus in the middle.

Its life-history is very similar to that of the Raspberry Weevil (*O. picipes*) and need not be referred to.

The same preventive measures as for the latter may be adopted.

As a remedy for the grubs nothing can be done but forking around the plants to clean the grubs out, and applying heavy dressings of soot well prong-hoed in, or Strawson's vaporite, which I have found quite effectual in killing weevil larvæ.

THE BLACK ANTHONOMUS.

(*Anthonomus rubi*. Herbst.).

This small weevil is in some seasons quite harmful to raspberries, but does not appear to have been called attention to by economic entomologists in this country. Fenouillet (1) has, however, recently worked out its life-history. It not only attacks the raspberry but also the strawberry, as shown by Fenouillet. Amongst its other food plants may be mentioned the bramble and roses.

It is closely related to the Apple Blossom Weevil, but differs much in colour.

During the summer of 1906 very considerable damage was done to the strawberry plants at Wye, and later at Penn in Buckinghamshire by this beetle.

The damage done is twofold : first, there is a loss in the yield of fruit ; and, secondly, the young shoots of the plant are checked.

Mr. Bickham informs me he has this beetle in his beds in Herefordshire.

LIFE-HISTORY AND HABITS.

The weevils are very busy about the latter half of May, when the blossoms are bursting into flower. It may be seen running up the leaf and flower stems, and making its way to the flower buds. The weevil deposits its egg in the closed blossom ; it then descends the flower stem to about $\frac{1}{8}$ inch below the bud, where it forces its rostrum into the delicate strig, severing the vascular bundles.

The weevil treats numerous other buds in a similar manner, also descending to the base of the stem, where it punctures the delicate young leaves and stems situated there, sucking out the plant juice.

The buds attacked by the weevil soon show they have been tampered with, for in about two hours they droop from above the puncture. In a day or so, the bud will either fall to the ground or remain on the flower stem in a shrivelled and brown condition. Similar results are noticeable in both the strawberry and raspberry.

At the expiration of a month the bud will be found to contain a footless grub, which pupates in the cavity it has formed. It remains in this stage from seven to eight days, at the end of this period a second generation of adult weevils appears.

This generation of weevils, though the season is too advanced for



FIG. 303.
BLACK
ANTHONOMUS.
(*Anthonomus*
rubi). (X 3.)

them to do further damage to that year's crop, yet injure the young shoots and leaves by puncturing them.

At the end of the year the weevils hibernate in a similar manner to the Apple Blossom Weevil.

The beetle is unicolorous black, clothed with distinct and evenly distributed but scanty greyish pubescence, which is closer on the breast and thicker on the scutellum; eyes prominent; head with a depression on the forehead; rostrum long and slightly curved, attached to which are the slender antennæ. Thorax broader at its base than its length, strongly narrowed in front and closely punctured elytra with strongly punctured striae, with interstices slightly convexed. Legs elongate and fairly slender, black, with knees and tarsi pitchy; all the femora with a small tooth. Claws of tarsi bifid. Length about $\frac{1}{8}$ inch.

NATURAL ENEMIES.

Fenouillet found on examining several of the buds containing pupæ that many of the latter had lost their insect-like form, and on keeping them Ichneumon flies appeared in the place of the weevils.

This natural enemy evidently serves as a partial check to the increase of the weevil.

TREATMENT.

Where the attack is on raspberries the beetle may be jarred off as is done for the Raspberry Beetle. On strawberries it is more difficult to deal with, and at present no suggestions can be made.

REFERENCE.

- (1) Fenouillet, G. Journal S. E. Agricultural College, No 16, p. 105 (1907).

THE SMALL STRAWBERRY FRUIT WEEVIL.

(*Eomias araneiformis*. Schrank.)

In 1908 this small weevil was reported as doing much harm to maturing strawberries at East Peckham, Kent.

There are no records of it doing damage in our scanty economic literature, but Fowler (1) refers to it as follows:—"Occasionally it does damage by burrowing into strawberries; locally abundant."

The same insect was sent from St. Mary Cray, and it was also found at work in my garden in the same year.

The damage appears to be twofold. The strawberries sent me from East Peckham were quite green, and the weevils had eaten away irregular patches over the surface, quite spoiling them (Fig. 305).

The attack I observed at Wye was different; the ripe fruit was

attacked, the little weevils eating out round holes into the fruit, usually but little larger than themselves.

These holes are very characteristic; they are round, the entrance being smaller than the space within. The beetles were found in these holes at dusk and early morning. This damage had previously been put down to slugs. I know nothing of the life-history of this insect.

The beetle varies from $\frac{1}{4}$ inch to a little over in length; it is elongated-oval in form, black in colour, some inclining to deep shiny brown; fresh specimens show scanty grey pubescence; the snout is broad and has a central furrow, and the long slender antennæ are red; the wing cases have very coarsely punctured striae. The legs are reddish. The male is very like the female, but the front tibiae are curved at the apex.

Fowler records this beetle as follows:—

London district, Kent and Surrey, common everywhere; it appears to be more or less general as far north as the Lancaster district and Cheshire, but it ceases entirely in the north and is not recorded from the Northumberland and Durham district, nor has Dr. Sharp ever come across a Scotch example, although it must be admitted that Murray records it as "occasionally in Scotland. Ireland, Malahide, near Dublin (Power), Armagh," etc.

Its habits seem very similar to those of other weevils. It shelters in moss, and is said to do so in woods.

I found in my garden that, by putting down large pieces of damp bark with moss on it between the rows, the beetles



[F. Edenden.
FIG. 305.—STRAWBERRY EATEN BY
SMALL WEEVIL.]

collected there and so were easily trapped. In future attacks this might be borne in mind and tried again.



[Horace Knight.

FIG. 304.—SMALL STRAWBERRY WEEVIL
(*Exomias araneiformis*).

Two species of the genus are known, both occurring in Britain, and both have been recorded at the roots of low plants and in moss (1).

REFERENCE.

- (1) *Fowler, Canon.* 'The Coleoptera of the British Isles,' vol. V., p. 191 (1891).

THE MINUTE RHYNCHITES.

(*Rhynchites minutus.* Herbst.)

Concerning this insect the following note occurs in the Board of Agriculture Journal (1):—

"Beetle on Strawberries.—From Grays specimens of beetles were forwarded, which were severely damaging strawberry plants. They

were identified as *Rhynchites minutus*, a widely distributed species of a genus that is sometimes destructive. *R. minutus* is found also on trees, and according to Fowler (2), especially on young oaks. Its pupal stage is passed in the soil. Unfortunately nothing can be done to combat this insect when adult except (where the beetles are in numbers) shaking them off the plants into a vessel containing some paraffin. The beetles may also be taken by sweeping the herbage with a fine net made of muslin or similar material."

Fowler (2) records this beetle from the following places:—Very widely distributed and common in many localities,

but local in the Midlands and rarer farther north; Scotland, scarce, but found in the Solway, Tweed, Forth, Clyde, Moray, and probably other districts."

It is also known as *R. germanicus*.

REFERENCES.

- (1) *Anon.* Board of Agriculture Journal, vol. XV., No. 4, p. 275. July (1908).
 (2) *Fowler, Canon.* 'The Coleoptera of the British Isles,' vol. V., p. 124 (1891).

THE STRAWBERRY CLICK BEETLE.

(*Adrastus limbatus.* Fab.)

This is a new enemy to strawberries, recorded in 1905 by Carpenter in Ireland (1). The beetle is only about $\frac{1}{4}$ inch long.



(H. Knight.)

FIG. 306.—*Rhynchites minutus.*

The shape is much like that of other Click Beetles. The head and thorax are shiny black, the latter with grey pubescence, the wing cases, legs and antennæ are pale ochreous-brown to ochreous-yellow.

It is common all over Ireland, according to Carpenter, and may be met with over most of England.

It mainly occurs in clearings in woodlands, where specimens may be readily swept off the plants upon which they live. The record shows that they were noticed in July at Limavady burrowing into the fruit.

The *Adrastus* has the foot claws toothed, and thus is easily told from the common Click Beetle (*Agriotes*).

Other Click Beetles are injurious in the wireworm or larval stage.



FIG. 307.—*Adrastus limbatulus.*

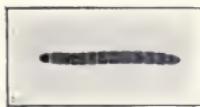


FIG. 308.—A WIREWORM.

REFERENCE.

- (1) Carpenter, H. Injurious Insects and Other Animals observed in Ireland during the year 1905. Eco. Proc. R. Dublin Soc., I., Part 8, p. 339 (1906).

THE STRAWBERRY APHIS.

(*Siphonophora fragariella*. Theobald.)

The first intimation I had of this aphis was from Mr. Harvey S. Bickham, who wrote me from Ledbury on the 6th of May, 1905, as follows: "I am writing to ask if you will be so kind as to tell me if the Green Fly, which is now attacking about two acres of my Stirling Castle strawberry plants, is likely to do any real damage to the fruit crop, and if so, would it be practicable to wash, say, 20,000 plants (the blossoms are just coming out here and there). The aphid appeared five or six days ago, so far as I can tell."

These plants were set out in February 1903 and were doubtless infested then, winter eggs being present. Writing again on the 17th of May, Mr. Bickham stated that he "thought from the presence of a large number of winged aphides a few days ago, that the attack was diminishing, but on carefully examining the plants to-day, I have come to the conclusion that the attack has merely spread wider

and farther over the field." Those that had the greatest amount of last year's old leaves on their crowns were the most affected. Writing on the 24th of May, Mr. Bickham stated that "though the attack is certainly a severe one, I cannot say that the blooms, which are now in profuse numbers, are on the whole smaller than they should be, but the stalks which carry them are not so thick and vigorous as they should be."

Plants sent were kept under control in the open, and it was observed that the trusses of blossom did not suffer very much, but the fruit was affected to no small extent. Yet in spite of what was undoubtedly a very severe attack at Ledbury, the grower picked over two tons of fruit to the acre.

This insect was not confined to Ledbury, observations showing it to occur for a considerable distance around, one record being some twenty miles away. Specimens of the same *aphis* were also sent me by Mr. Buley from Woodnesborough, near Dover. So far Hereford and Kent are the only localities recorded. Probably it will be found elsewhere. The plants were kept under careful observation for some time, and repeated generations of lice were produced, and two winged generations occurred. During a few days' absence from home, the plants were left and dried up, and the history was broken until early in February, when plants from the worst part of the attacked beds near Ledbury were received. These were carefully examined, and black *aphis* eggs were found on the leaves in small numbers. The ova were in all cases placed on the underside of the leaves near a vein, some near the mid vein, others almost at the edge of the leaf, but always lying alongside a vein. Certainly most were found on old leaves, but not all; one or two on quite young ones. This shows that the oviparous females must have occurred very late, later even than we get in the apple aphides.

The ova commenced to hatch on the 12th of March and continued to do so until the 5th of April. The young coming from these winter eggs were very sluggish, dark green, lice. Early in April they became more active and grew more rapidly, and became fully-formed "stem mothers" by the middle of the month and were busy reproducing. Careful search was made at the roots of the infested plants, but no trace of any aphides could be found. It is, therefore, apparent that this strawberry *aphis* passes the winter solely in the egg stage on the leaves and does not migrate.

One noticeable feature is that where there is an excessive and dense foliage the *aphis* is most abundant. On opening some of the plants sent from Hereford, literally thousands of lice and winged

fly and masses of white exuviae were found. Nevertheless, there were numbers, according to Mr. Bickham, on some young Paxtons, which had only three or four leaves per plant.

No doubt dense, close growth helps them in bad weather, but we are sure to find it on plants of all ages and stages.

From plants kept under observation during the greater part of a year I feel sure that the whole life-cycle is passed on the strawberry. That it may occur on the wild strawberry and other plants is possible, but at present we have no evidence that it does so. A closely allied species is found on the wild strawberry which was described by Koch as *Siphonophora fragariae*. Speaking of this aphis Buckton (2) says: "I never before the year 1876 saw the garden strawberry attacked, but in June of that year the stalks of the unripe fruit were much infested. Mr. Smee, however, remembers other seasons in which an aphis was common on the strawberry plant *Fragaria vesca*." Infection may easily be spread by nursery stock, by means of the eggs attached to the leaves passing unnoticed.

The aphis not only prevents many trusses from bringing their fruits to a marketable size, but many of them settle on the fruits themselves, sheltering between the fruit and the calyx.

The attack lessened as the fruit got ripe and the leaves hardened, and few were noticed at the end of picking. None were noticed by Mr. Bickham on the worst plantation after picking, but they continued on the young plants.

Mr. Fuller, Government Entomologist of Natal, records the introduction of the Strawberry Aphis into the Colony on English plants, but they were all wisely fumigated, so that the pest did not spread.

DESCRIPTION.

Apterous viviparous female.—Body, bright shiny green somewhat yellowish towards the centre. Head and thoracic segments pale yellowish-green. Eyes black. Cornicles long and thin, green with a minute black apex. Antennæ very long, pale fawn, with dark tips to the segments. Legs fawn coloured, uniform except the extreme apex of the tibiæ and the tarsi, which are black. Proboscis short, yellow, with dusky apex. In some lights the antennæ look fuscous on the apical half. Length $\frac{1}{5}$ to $\frac{1}{4}$ inch.

The pupa is entirely pale green, except for dark apices to the tibiæ and the black tarsi. Antennæ green with minute black apices to the basal segments forming three black spots, apical half of the

antennæ dusky; cornicles green with black apices. Eyes black. Wing buds all pale green. Slightly larger than the female.

Winged viviparous female.—Head and antennæ deep green to olive-brown; the two basal segments of the antennæ very deep brown, base of the third pale grey. Eyes deep brown. Prothorax olive-green, a pale green band before and behind; thoracic lobes blackish, rest of the thorax deep green. Abdomen, bright rich green above, with an irregular median dusky line and broken dusky apical border to the segments, green below and with three lateral dusky spots on the sides, running up to the cornicles. Proboscis green at the base, shiny black at the apex. Cornicles jet black. Legs fawn coloured, femora and tibiae black apically; tarsi black. Wings with grey stigma. The *lice* coming from the winter eggs are deep green. The *ovigerous female and male* were, unfortunately, not noted. The eggs are elongated oval, shiny black in colour.

NATURAL ENEMIES.

No Ladybirds were noticed feeding on this *aphis*. This is where some foreign Ladybirds might do good; for it seems, judging from what little has been done in this country in introducing them, that they prefer to work low down, probably owing to getting greater shelter, and amongst the dense growth of strawberry leaves they would find all they want.

Chalcid flies (*Chalcididae*), however, appear to do some good, for on the 11th of June, numbers of *aphis* were sent me from Hereford and some from Kent which had been attacked by these useful insects. In one or two instances the strawberry leaves were covered with brown dead aphides.

PREVENTION AND TREATMENT.

The old leaves should be cut right back late in the winter, raked together and burned. Very many eggs will then be destroyed. Some are sure to escape, for they were found in the crowns of one plant examined.

Spraying is difficult if left until the trusses are coming out. The dense growth of leaves protects many of the lice, and even a few left may be sufficient to account for some thousands later.

In 1905 the ova were hatching out in the latter part of March. By the beginning of April would then be the time to give the plants a heavy spraying with soft soap and quassia to kill the young lice

coming from the eggs before they become mature "stem mothers" and commence to produce the living young.

Where beds have been infested in the previous year it would certainly pay to take a sprayer over them two or three times before the blooms open.

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- (1) *Theobald, F. V.* Report on Economic Zoology for year ending April 1st, 1905, p. 33 (1905).
- (2) *Buckton, G. B.* 'Monograph of the Aphides,' vol. I., p. 125 (1875).

THE STRAWBERRY SNAIL.

(*Helix rufescens.* Penn.)

The Strawberry Snail (*H. rufescens*, Pennant) is a constant source of annoyance to strawberry growers, preferring those plants, violets and iris to all others. I have seen beds of strawberries in Surrey and Cambridgeshire quite spoilt by this snail. The fruit is attacked as well as the young leaves. These snails are seldom seen in the daytime, unless after a shower of rain, when they at once become active. They may often be seen in the summer under the straw which is placed between the plants. It has been noticed in gardens where lawn-mowings have been used instead of straw that the snail is not so harmful, but the benefit of straw over the grass is too apparent to pay any attention to the snails, which must be combated in some other way. They deposit their eggs from September to November, each snail laying about sixty eggs. In a breeding-case the eggs were laid on the ground in heaps, but naturally it is probable that they place them below the surface of the soil. The ova hatch in about three weeks, but a few remain undeveloped until the spring. The small snails do not grow very rapidly, as is the case with the large garden snail, *Helix aspersa*. The shell is compressed above, and angularly rounded below, opaque pale dirty grey, often with a reddish-brown hue, sometimes transversely streaked with brown and marked with a white spiral band which passes round the last whorl; whorls 6—7; last whorl = $\frac{1}{2}$ -shell; mouth obliquely semilunar, furnished inside with a broad white rib. The body of the snail is yellowish-brown with dark brown stripes running along the neck and on the tentacles; foot pale, narrow and slender.

TREATMENT.

This snail may be kept in check in strawberry beds by heavy dustings of soot or a mixture of one part lime, ten parts naphthalene, to one hundred parts of fine ash broadcast over the beds when the fruit has set.

NATURAL ENEMIES.

In spite of damage done by the Thrush (*Turdus mucivorus*), there is no doubt but that this beautiful song-bird does much good by devouring this snail in large numbers.

SLUGS.

(*Limacidae*.)

Slugs cause a good deal of loss to strawberry growers and at the same time they do no little harm to the gooseberry, as is pointed out on page 282.

Of slugs the three most destructive species are *Arion ater*, *Agriolimax agrestis*, and *Limax maximus*.

Arion ater (Linn.), or the Black Slug, is found in damp woods, gardens and hedges; and during the day under stones, logs of wood, and even tunnelling under ground; it reappears, however, directly after rain, and attacks all kinds of soft succulent leaves. It is a great pest in gardens. At the same time it acts as a scavenger. This species has a variety of names on account of its variable colour. Féruccac named it *A. empiricorum*, on account of the calcareous matter found under the shield having been used in medicines. It is also now identified with *A. flavus*, though at one time considered to be a distinct species. The shell of *A. ater* consists of small separate calcareous grains of unequal size. The colour of the body varies from black to red, yellow, green, brown, and occasionally a dirty yellowish-white, covered with large prominent tubercles, often much contracted and rounded in front and somewhat pointed behind; the mantle is paler than the rest of body; the tentacles much swollen distally; foot with yellowish border; slime of a yellowish colour. The eggs, which are oval, white, opaque bodies, take about a month to develop. The young grow slowly, and apparently do not attain the adult condition until they are a year old. This slug has frequently been reported and observed as an enemy of ripe strawberries.

Agriolimax agrestis (Linn.), the Grey Field Slug, is by far the most injurious to vegetation, of all the land mollusca. It may be found in almost every garden and field throughout this country and most parts of Europe, as well as in Siberia, Madeira and Algeria. Like all slugs its life is dependent on moisture. In dry weather we find it rolled up under a stone, coming out to feed by night and during wet weather. According to one authority, this mollusc feeds upon earthworms. In this case it had probably been mistaken for one of those beneficial slugs (*Testacella haliotidea*) which prey upon earthworms and other slugs. The body is spindle-shaped, ashy grey, with reddish or yellowish tinge, and sometimes mottled; early in the year it is of a much paler colour; the shield is large; the foot has pale sides; and it exudes an abundant viscous slime. The shell is oval and concave on the underside, very thin, marked with indistinct lines of growth, with a broad membranous margin obliquely striated.

This species is most prolific; as a rule seven or eight distinct batches of fifty ova each are annually produced. The breeding season is from May to November. The ova are deposited in heaps of six to fifteen, in the ground and amongst moss. August, September and October are the chief breeding months. A single snail will lay as many as 500 ova in the season. The eggs take three or four weeks to develop, the young being about $\frac{1}{2}$ inch long. Some that I kept reached the adult state in about two months, but they more often take much longer to reach maturity. These slugs live many years. The ova have great resistive powers as regards temperature and drought. The Grey Field Slug is the worst pest of strawberries, and it is this species which attacks the blossoms of the gooseberry. Mr. John Riley of Putley Court, Ledbury, was the first to trace this damage to slugs (1). His bailiff also noticed similar damage near Evesham, which had been erroneously put down to frost. Mr G. Hooper of Pershore also sent me blossoms damaged by them, and similar reports have been sent from near Canterbury and they have been watched at work at night at Wye. In the winter months this slug may be found in large numbers under stones, decaying logs and rubbish, in a semi-torpid condition.

Another species now and then found in the strawberry bed is *L. maximus* (Linn.), the Black-striped Slug, the largest of its kind, which sometimes reaches a length of 7 inches. Although not very prolific it does some harm. It is very inactive, and exudes a thick gummy iridescent slime. The ova are deposited in little clusters, agglutinated by mucus, during the autumn, and in about four weeks

are hatched. The young at once commence to devour the nearest vegetation. This species will live for some years; one I kept for five years continued to grow all the time. Its shell is somewhat rectangular, elongated and convex above, crystalline and glossy, with distinct lines of growth; margin very thin. The body is slender, variable in colour. Some are black; others yellowish-grey, and spotted with black and white; numerous tubercles cover the skin; tentacles, long and yellowish-brown; back very much rounded; foot edged with white. Slime iridescent when dry, white when fresh.

TREATMENT.

In strawberry beds and gooseberry plantations there is no better way of getting rid of slugs than penning ducks on the land. Ducks devour slugs with great avidity and will soon clear these pests off. Several dressings of soot and lime are also beneficial. Vaporite I have found most effectual for destroying slugs.

THE STRAWBERRY EELWORMS.

Cauliflower Disease Eelworm.

(*Aphelenchus fragariae*. Ritz. Bos.)

The so-called Eelworm disease of strawberries is partly due to *Tylenchus devastatrix*. The disease dealt with here first is also an eelworm disease, but is due to a different celworm, known as *Aphelenchus fragariae*, and it produces a curious cauliflower-like appearance in the plant, whilst the former merely cause a gradual decay or rotting away of the roots and crown.

The cauliflower disease is not very widely distributed. I have only once seen it in Kent, near Swanley. Carpenter (1) records it from Ireland, at Bray, County Wicklow, and Ormerod (2) from St. Paul's Cray, Kent, and specimens have been sent me from Southampton and Surrey.

The presence of these eelworms causes a great change in the growth of the plants, affecting mainly the short stems and the inflorescence just when the blossoms should be appearing. The stems become much swollen and the buds crowded into a cauliflower-like mass and do not develop. When a few blossoms do show they are much deformed and very small. The minute eelworms are found in numbers in the buds.

LIFE-HISTORY AND HABITS.

The minute worms vary in the female from 0·75 to 0·80 mm., in the male from 0·6 to 0·85 mm. in length; in colour they are white, and, as in all eelworm plant-feeders, they have an oral stylet,



[F. Edenden.

FIG. 309.—STRAWBERRY PLANT ATTACKED BY EELWORM (*Aphelenchus fragariae*).
(One-third natural size.)

which is small in this species. For full details the student is referred to Ritzema Bos's paper (3). The worms breed and reproduce in the plants. The main stem of the plant grows up, but suddenly branches vigorously, and these branches remain united in

a mass, and this mass thickens like a piece of cauliflower; numerous buds appear in the axils of the lower leaves, but never grow out into stolons. All sorts of queer shapes are produced by different abnormal growths. Some stems split at the top of the fasciation into a number of different branches, with a few abnormal flowers and leaves. The sheathing leaves are irregular, small and twisted, and the flower-buds grow out into thick deformed masses.

The appearance is shown to some extent in the photograph reproduced here (Fig. 309).

How the disease comes we at present do not know. Probably the worm feeds on other plants and is carried casually to the strawberries. Carpenter (1) suggests that it was imported into Ireland with runners from plants already affected, and mentions that Royal Sovereigns were worse than any others.

REMEDY.

None is so far known. Carpenter records that sulphate of potash had no effect in Ireland. It would scarcely do so in one year, as the worms appear to live very largely in the plants, but it is worth while to experiment with it further, as the effect on eelworms is very good as a rule.

REFERENCES.

- (1) Carpenter, G. H. Injurious Insects and Other Animals observed in Ireland during the year 1905, p. 338. Eco. Proc. Roy. Dublin Soc., I., pt. 8 July (1906).
- (2) Ormerod, E. A. 'Handbook of Orchard and Bush Fruit Pests,' p. 251 (1898).
- (3) Ritzema Bos. Overgedrukt nit het maanblad voor Natuurwesenschappen, No. 7, Jan. (1889).

The Root Eelworm.

(*Tylenchus devastatrix*. Kuhn.)

During the last few years there has been a great mortality amongst strawberries. The plants rot and decay away just below ground and at ground level. In all cases examined the plants have been badly infested with eelworms, these I have been unable to separate from the common *Tylenchus devastatrix*. This disease has been reported to me from Worcestershire, Kent, Nottinghamshire, Surrey and Hampshire. There are no marked symptoms such as seen in the former, the plants merely rot away, roots and crowns

decay; the leaves in some I have noticed become rather crinkled and deformed, and numbers shrivel and die.

Specimens showing this eelworm as undoubtedly the cause of decay have been received from several places in Kent and from

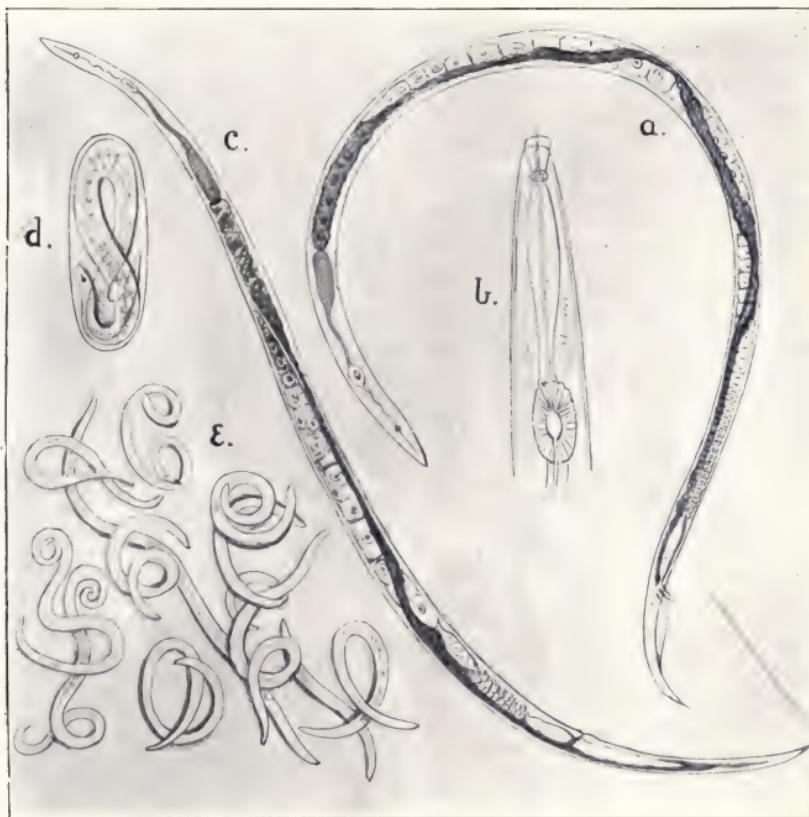


FIG. 310.—THE ROOT EELWORM (*Tylenchus devastatrix*).

a, adult male; b, cephalic end, showing mouth spine; c, adult female; d, ovum and embryo (all greatly enlarged); e, group of worms (much enlarged).

(After Ritzema Bos.)

near Worcester. Mr. Emptage informs me he has had plants showing this disease sent from several localities in Britain.

This eelworm is the cause of tulip root in oats; it is also the cause of disease in onions, clover, hyacinths, etc.

As far as personal observations go it also exists in large numbers in decaying roots; it may often be found in decaying hop roots, in decaying cabbage stumps, etc.

LIFE-HISTORY.

The worms live and breed in the plants, and also exist in numbers in all stages in the ground and in manure. They reproduce with great rapidity. The female is about $\frac{1}{20}$ inch long, but varies from $\frac{3}{10}$ to $\frac{1}{5}$. Soil which once becomes infested may, it appears, remain so for some years.

On the death of a plant the eelworms move into the soil and on to the next one.

Strawberries when attacked usually go off in patches, the worms spreading out from an infested plant.

REMEDIES.

The two chief substances found to affect this worm are lime and sulphate of potash. Dressings of these and the destruction of any diseased strawberry plants are things we must aim at to keep this pest in check.

VINE.

INSECTS INJURIOUS TO THE VINE.

COLEOPTERA.

- THE VINE WEEVIL (*Otiorhynchus sulcatus*. Fab.). Foliage and Shoots, p. 460.
THE RASPBERRY WEEVIL (*Otiorhynchus picipes*. Fab.). Foliage and Shoots, p. 425.

LEPIDOPTERA.

- THE APRICOT AND VINE MOTH (*Batodes angustiorana*). Foliage and Ripe Fruit, p. 181.
Eupacelia ambiguella. Hb. Flower buds and young Grapes.
Tortrix relinquana. Hb. Flower buds and young Grapes.
Aenectra pilleriana. Hb. Foliage.

HYMENOPTERA.

- WASPS (*Vespidae*), p. 129.

DIPTERA.

- THE GRAPE FRUIT FLY (*Drosophila melanogaster*. Mg.). Fruit, p. 480.

HEMIPTERA.

- THE PHYLLOXERA (*Phylloxera vastatrix*. Planc.). Leaves and Roots, p. 486.
THE VINE SCALE (*Pulvinaria vitis*. Linn.). Wood, p. 481.
THE MEALY BUGS (*Dactylopius citri*, Risso, and *D. longispinus*, Targ.-Tozz.). Wood and Fruit and Leaf, p. 483.

THYSANOPTERA.

- THRIPS (*Heliothrips haemorrhoidalis*). Leaves.

ACARINA.

- RED SPIDER (*Tetranychus telarius*. Linn.). Foliage, p. 488.

THE GRAPE FRUIT FLY.*(Drosophila melanogaster. Mg.)*

This fly, well known on the Continent and in America, is fairly common in parts of Britain. It was first recorded as a vine pest in this country by Austen (1), but there are records of similar attacks in America.

Forbes (2) refers to the damage done to the grape crop at Moline, Illinois. The damage recorded by Austen was done to a crop of Lady Downe's seedling at Thongsbridge, near Huddersfield. This was the only variety attacked. Several of the maggots were found in each berry. Its usual food seems to be decayed or decaying fruit and other vegetable matter, and it also breeds in fermenting liquids.

Williston (3) refers to it appearing in "clouds" around heaps of cider refuse, and states that it never attacks sound fruit.

On the other hand, Comstock (4) refers to it as the "Vine-loving Pomace Fly," and quotes Mr. W. L. Devereau, of Clyde, New York, as follows:—"The larvae of this fly completely eat out the inside of grapes which, while hanging on the vines, have first been picked open by birds. The decaying juices running out on the other berries spread decay and thus give more foothold for the larvae. Indeed the larvae bore from one grape to another, while the imagines are constantly, by eggs, putting in new colonies until the cluster is nearly or quite destroyed, nothing remaining but the empty grape skins."

Melichar (6) records it "in countless myriads in an open barrel half full of rotten and fermenting fruit."

Howard (10) has bred it from human excrement.

Its wide distribution including, besides America and Europe, Western Australia, South Africa, Cuba, points to its being spread artificially. Such we can see may readily happen in cargoes of unsound fruit.

LIFE-HISTORY.

This has been worked out by Howard (5). The fly measures about 2 mm. in length. The head, thorax and base of the abdomen are dingy yellow. The abdomen is banded with brown at the base and the apex black. The male can at once be told by the presence of a small black comb-like structure on the inner side of the first front tarsi.

They lay their eggs on any decaying or fermenting matter, and the larvae hatch and develop very rapidly—a generation may develop

in twenty days or less. The larva when full grown reaches 4 mm. in length; it is rather active for a footless grub, yellowish-white in colour with black mouth hooks and a pair of prominent orange coloured spiracles at the hind end, placed on a protuberance on the upper edge of the last segment.

It pupates amongst the decaying vegetation. The puparium is 3 mm. long, yellowish in colour; in front is a flattened depression with the branched larval cephalic spiracles projecting from the corners, and the posterior stigmata prominent. It appears to winter in the puparium stage.

TREATMENT.

The main thing to see to is the cleanly condition of the grapes. A few mouldy or fly or wasp damaged berries might attract these flies and so further harm be done to the bunches. Netting should be placed over the open lights and windows, but to be effective in keeping these flies out it must be smaller meshed than that usually used to keep out flies and wasps; muslin would be best for this purpose.

REFERENCES.

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- (8) *Cockerell, T. D. A.* Bull. 32. Arizona Experiment Station, pp. 290-294.
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THE VINE SCALE.

(*Pulvinaria vitis.* Linn.)

This is a readily distinguished scale insect which attacks the vine and peach under glass.

It does not seem to be very common in this country, but now and then specimens are sent from both food plants. It is also found out of doors on hawthorn, and birch, willow, alder and cotoneaster spp.

Newstead (1) records finding it in Delamere Forest on birch, and in Cheshire it has been found on willow. Newstead also records it



[F. Edenden.]

FIG. 311.—WHITE OR WOOLLY VINE SCALE.
(*Pulvinaria vitis.*)

from Chichester, Doncaster and near Maidstone, from Stonehouse, Devon, and records it as being common on peach in a few localities in Cheshire.

Douglas has found it on birch at Lewisham and records it from Hereford on vines. Specimens have been sent me from several localities in Middlesex and Surrey and two from Kent, all on vines and peaches under glass. Fernald (2) records it from the United States.



FIG. 312.—*Pulvinaria vitis* ♀.
(Greatly enlarged.)

leaden-grey colour. It is figured natural size.

The larvae have two anal setæ which are about half the length of the body.

The young female resembles the Peach Scale (*Lecanium persicæ*), later it becomes transversely wrinkled with a deep cleft at one end with a median pale ochreous or deep brownish-red line and the edge of the scale turned upwards, and a dense pad of white wool appears forcing one end of the insect away from the surface of the plant, and the female becomes more wrinkled and often, I find, of a

TREATMENT.

These large prominent scale insects may be killed by painting or sponging with paraffin emulsion, or may be destroyed by hand, which seems to be the most usual plan.

REFERENCES.

- (1) Newstead, R. 'Monograph of British Coccidae,' vol. II., p. 51 (1903).
- (2) Fernald, Maria E. 'A Catalogue of the Coccidae of the World,' p. 140 (1903).

THE MEALY BUGS.

(*Dactylopius citri*, Risso, and *D. longispinus*, Targ -Tozz.)

There are two mealy bugs found on vines under glass and on many other plants in this country, where they do considerable damage.

The common species, *D. citri*, has also been found out of doors on the ivy-clad walls of a hothouse at Kew and in a few other places, but Newstead tells us he has not known it thrive long in such places. The difference between these two white mealy Coccids can at once be seen; *citri* has short processes, *longispinus* very long ones.

They shelter in crevices and under the skin of the vines, where their white woolly secretions soon cause them to be detected. In this country under glass the mealy bugs breed all the year round.

The adult *D. citri* female is elongated oval and covered with white mealy wax, except at the articulations of the segments, and the waxy marginal appendages are seen to differ from those of *D. longispinus*. The length varies from $\frac{1}{2}$ to rather more than $\frac{1}{4}$ inch.

The male is winged and is found in summer in hot weather. The colour is reddish-brown and mealy, the two wings with intense blue iridescence and the abdomen with two long caudal filaments.

D. citri is a great pest out of doors on oranges in South Europe.



[J. G. Blakey.
FIG. 313.—FEMALE MEALY BUG. ($\times 8$)]

D. longispinus also occurs in the open in South Europe, Africa, Ceylon and the West Indies.

TREATMENT.

In vineeries the best treatment is fumigation with hydrocyanic acid gas. For this purpose the quantities used vary. It is necessary

to have a separate machine for fumigating for every 10,000 cubic feet of space in a viney.

A fan should be fixed over the fumes so as to spread them evenly over the house, and the time the fumes are allowed to remain should be about forty-five minutes. No other treatment is quite satisfactory, and even the gas treatment wants repeating twice at an interval of about two weeks (*vide* Fumigation).



[J. G. Blakey.

FIG. 314.—YOUNG MEALY BUGS JUST HATCHED. (× 3.)

The quantities experimented with by Cousins (1), who first brought this treatment out in this country, are quoted here *in extenso* :—

“VINERY A.—Capacity, 3,430 cubic feet.

Early variety. Treated when vines in full bloom.

Cyanide, 18 oz.; acid, 27 fluid oz.; 1 quart water.

Temperature, 60° F. Time, half an hour. After sunset.

“Result.—Mealy bug destroyed, foliage unhurt, but three-quarters of the bloom injured. A few mealy bugs appeared at the close of the season after the grapes had been gathered. A second fumigation was therefore decided upon, and the results so far have been completely satisfactory.

“VINERY B.—Capacity, 3,825 cubic feet.

Late variety. Treated before vines bloomed.

Cyanide, 27 oz.; acid, 40 oz.; water, 60 oz.

Time, 3 hours. After sunset. Temperature, 60° F.

"Result.—Mealy bug destroyed. No injury to vines. A few appeared in the autumn and a second fumigation was given, with the same success as in the previous case.

"VINYER C.—Capacity, 1,990 cubic feet.

Early variety. Treated when grapes the size of peas.

Cyanide, 6 oz.; acid, 9 oz.; water, 15 oz.

Temperature, 65° F.; weather very sultry at time. Time, 40 minutes.

"Result.—Grapes browned and killed. Entire crop lost. Foliage uninjured. Mealy bug destroyed. The viney was kept on the cool side, plenty of air given, and splendid growth and promise of fruit for next year was obtained.

"A few mealy bugs appeared in October. Fumigation was repeated. All the bugs were destroyed. The season had so far advanced, however, that eggs were to be found on the shoots.

"Painting the rods with the winter alkali wash in spring and a fumigation before the bloom appears have been decided upon."

The result of these experiments led Cousins to summarise treatment as follows:—3 oz. cyanide, 5 oz. acid, 8 oz. water per 1,000 cubic feet, either before the vines bloom or when grapes are colouring or after the crop has been gathered. Avoid fumigation when the vines are in bloom or before the grapes have commenced to ripen.

We may take the latter precautions to apply generally.

Considerably less of the chemicals have been used with success. For instance, Miss May Crooke, experimenting at Bredon's Norton School of Gardening (2), found that 3 oz. of 98 p.c. potassium cyanide, 1½ oz. fluid sulphuric, and 4 oz. of water killed all the mealy bugs in 1,920 cubic feet of space.

At Swanley College a large viney of 17,750 cubic feet space was fumigated in December for forty-five minutes with 1½ oz. sodium



[J. G. Blakey.

FIG. 314A.—MEALY BUG (*Dactylopis longispinus*).
($\times 8$.)

cyanide, $1\frac{1}{2}$ oz. sulphuric, 2 oz. water to every 1,000 cubic feet of space, three machines being used.

This was found to kill the mealy bug near the machines, but although fans were kept constantly going, some were alive between the fumigation centres.



[J. G. Blakey.]

FIG 315.—MALE MEALY BUGS. ($\times 8$.)

Besides fumigation, mealy bug may be checked by painting with paraffin or methylated spirit, or with lime, sulphur and paraffin, having previously scraped the wood.

REFERENCES.

- (1) *Cousins, H.* Journal S. E. Agricultural College, No. 9, p. 69. April (1900).
- (2) *Theobald, F. V.* Report on Economic Zoology for the year ending April 1st, 1907, p. 82 (1907).

THE PHYLLOXERA.

(*Phylloxera vastatrix*. Planck.)

This most serious vine pest has often been found in Britain on vines under glass. It was known in England in 1863. The Phylloxera of the vine is an American insect, which spread rapidly when once introduced into Europe over France, Portugal, Switzerland and Germany, and has occasioned enormous loss in France. American vines seem to withstand its attack, but European varieties suffer severely, both in California and in Europe. It has also made its way into Australia and the Cape. The insect is found in two different forms, one on the leaves and another on the roots. The

At sufficient strength the eggs also can be killed, and it is best to use this strength, but only on dormant vines.

The proportions are for every 100 cubic feet, $\frac{2}{3}$ to $\frac{1}{4}$ oz. of potassium cyanide or $\frac{1}{2}$ to $\frac{1}{5}$ oz. of sodium cyanide, and for each ounce of cyanide 1 liquid ounce of sulphuric acid previously diluted with 3 to 4 oz. of water.

For dormant vines the greater strength may be used, but not on the plants when in foliage.

leaf form produces yellow to greenish-red galls of various shapes. The root form, which is the more destructive, causes swellings on the young rootlets, which then decay, and then the aphides collect on the larger roots, which also decay away. During the first year of the insect's attack no very marked symptoms show, but in the second year, growth is checked and the leaves look yellow and unhealthy. If left the vine dies, and the aphides migrate to another if they can. This migration may be in the soil or above the ground. In winter the lice may become torpid and assume a dull brownish hue; in spring the young lice cast their skins and mature and deposit eggs, and the young from these soon become oviparous females and lay ova again. Several generations of these egg-laying females may occur and in summer winged forms appear. These come above ground and fly from vine to vine and deposit pseud-ova beneath the leaves and on the wood and near the ground. There may also be a migration of actual root forms to the leaves where they form galls.

The so-called "foundress" *Phylloxera* has a nearly circular or flask-shaped body of an amber-yellow colour, or she may be ferruginous in hue, spotted from the ova in her body. This form comes from a true egg laid in autumn by the sexual female. If an aerial foundress, she punctures the leaves and becomes enclosed in the swelling mass, and the leaf becomes studded with gall-like bodies. Each foundress forms a single gall within which hundreds of pseud-ova are laid. The galls are round and fleshy and great numbers may occur on a single leaf and the leaves die in consequence. On the roots they form small tubercles, these are caused by the young *Phylloxera* which have developed in the leaves and have escaped from the galls. It is this subterranean race which causes such harm in Europe, whilst the aerial race is the worst in America—just the reverse of what we see happens with the Woolly *Aphis*.

The subterranean females are also amber-yellow and they deposit ova of a pale shiny yellow colour. These give rise to young which go on feeding on the roots and cause the nodules on the fibres and loosen the cortex on the larger roots. In the summer many of these apterous lice become nymphs and come to the surface, where they assume wings and fly about. These winged females produce pseud-ova, and through them true males and females arise. These winged females place the pseud-ova on the down of the underside of the leaves and on the wood.

The males and females coming from these are very small, and mouthless and wingless. The male is pale ferruginous yellow and the female the same, but larger, and contains but one egg, which she

lays about the fourth day after she is hatched. This true egg is olive in colour and it may survive all through the winter.

A subterranean race only may occur on a vine.

When this serious pest is known to occur under glass in this country it is best to at once grub up the vine that is attacked and burn it.

Bisulphide of carbon injected into the soil will kill the root form, but it must be done very thoroughly, many small injections being made.

American and Australian stocks are resistant of this disease, and the introduction of the former has done much to lessen the damage caused by this pest in Europe.

Care should be taken to see that vines are clear before they are planted in this country under glass, especially if they are imported from abroad. Any found to show any symptoms of the root form should at once be burned.

RED SPIDER.

(*Tetranychus telarius*. Linn.)

This well-known vine pest also appears on many other plants, but it must not be confused with the Red Spiders of fruit out of doors (*vide Bryobia*, etc.). It feeds upon the leaves, usually on the undersides, and causes them to become mottled or marked, and then rusty in colour. Unlike the *Bryobia* of the gooseberry it spins a dense yet fine network of silk under the leaves, amongst which it lives and breeds. The presence of this fine silken webbing protects it from ordinary contact washes to a considerable extent. The delicate silken threads are passed out through a conical nipple situated underneath near the apex of the body. The threads of the webbing are very delicate, and are not very noticeable even with a lens until numbers become matted together. The delicate strands are guided by the Red Spider's feet, and are attached to the fine hairs, veins, etc., of the leaf.

Dry, warm, and sunny weather favours the reproduction of the mite.

The eggs are almost colourless, and spherical in form. They are deposited irregularly in the webbing and hatch in a few days under favourable circumstances into little six-legged mites, which gradually grow, moult their skin, and become the eight-legged nymphs and then sexual adults. The legs are all of nearly the same length, and thus

this Red Spider, the *Tetranychus*, can at once be told from one of the non-web-weaving *Bryobius*. The winter appears to be passed in two ways under glass, namely, in the egg stage on the wood and buds, but more usually as immature or mature mites under the skin of the wood or in any convenient shelter.

TREATMENT.

This consists of either washing, dusting, or fumigating.

Red Spider strongly object to cold water, and frequent syringings in an early stage of attack with plain water will often stave off attack, but it is useless when any amount of webbing has been formed. Spraying with liver of sulphur and soft soap is generally of benefit, but by far the best method is fumigating with sulphur. An old and excellent plan, if done carefully and at the exact temperature (the knowledge of which seems to be gained only by experience), is to paint the stove pipes with flowers of sulphur. At times damage is done in this way, depending, it seems, entirely on the heat of the pipes and house. It is better to use sulphur fumes spread by means of proper machines, such as that made by Campbell of Manchester.

Very inferior results have been obtained with hydrocyanic acid gas, and sulphur fumigation seems to be the best remedy we yet have.



FIG. 316.—OVA OF RED SPIDER AND TRANSPARENT YOUNG
JUST HATCHING.
(Greatly enlarged.)

APPENDIX.

A.—SOME INSECTS WHICH MIGHT BECOME PESTS IN THIS COUNTRY OWING TO IMPORTATION.

THE JAPANESE FRUIT SCALE (*Diaspis pentagona*. Targ.-Tozz.).

THE SAN JOSÉ SCALE (*Aspidiotus perniciosus*. Coms.).

THE MEDITERRANEAN FRUIT FLY (*Ceratitis capitata*. Wied.).

CHERRY FRUIT FLY (*Rhagoletis cerasi*. Linn.).

These have been already recorded in this country ; the second I found on some American pears in a London shop, and the third and fourth are given by Mr. George Verrall in his list of British Diptera. The Japanese Fruit Scale has been found by Mr. Newstead.

THE MEDITERRANEAN FRUIT FLY.

(*Ceratitis capitata*. Wied.)

This fruit fly is recorded by Verrall in his list of British Diptera. It must, however, be very rare, and its record probably is in connection with imported fruit, for at one time imported oranges could frequently be found with these maggots in them. It is a widely distributed insect, being common in Southern Europe, Malta, the Azores, the Canary Isles, Bermuda, Australia, Natal, the Cape, China, Brazil, etc. Its larvae feed in peaches, nectarines, apricots, oranges, citrons, loquats, guavas, prickly pears, etc. In parts of Spain the cultivation of peach, apricot and nectarine was abandoned on account of its ravages.

The fly (Fig. 317) is very marked in ornamentation, especially the wings. In length it is little more than $\frac{1}{6}$ to $\frac{1}{5}$ inch, with wing expanse of over $\frac{1}{3}$ inch ; the thorax is black, marked with grey-brown ; the short, broad abdomen orange-yellow, the first two segments with deep apical bands of silvery-grey ; the wings have black lines and spots at the base, with dark bars, as shown in the figure.

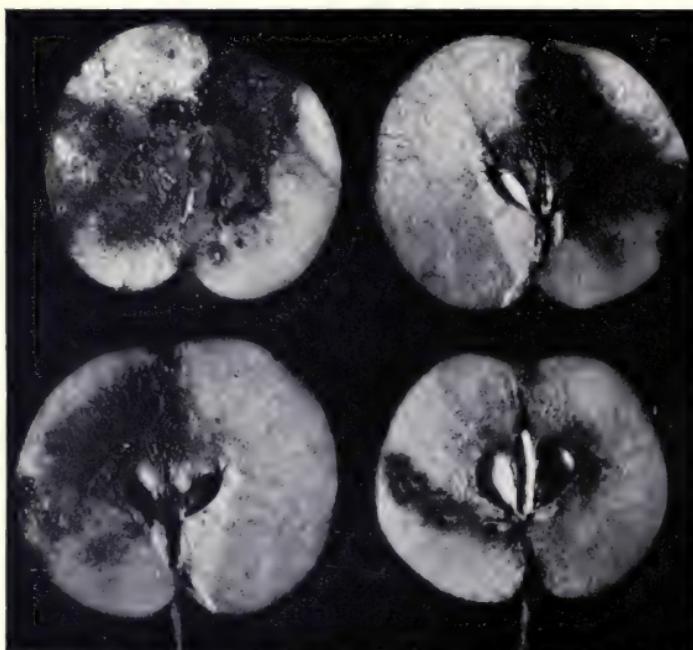


[H. Knight.
FIG. 317.—MEDITERRANEAN FRUIT FLY
(*Ceratitis capitata*).

LIFE-HISTORY AND HABITS.

The female lays her egg in the fruit by means of a sharp ovipositor usually numbers are laid together. They hatch in from two to four days, and the footless grubs live in the pulp, living in varied ways in the different fruits—for instance, in apricots they work to the very centre. The maggots live from two to three weeks, and then leave the rotten fruit and pupate in the ground.

The puparium stage lasts from twelve to twenty-one days. In warm



[C. Fuller.]

FIG. 318.—APPLES ATTACKED BY FRUIT FLIES (*Ceratitis*).

climates the whole life-cycle may take but twenty-eight days, and there are several overlapping broods.

This pest is one readily spread in diseased fruit, and countries which have taken an interest in fruit cultivation naturally protect themselves against the introduction of this serious enemy. The fact that it is recorded as British must not be overlooked.

Fortunately, through the great work of Professor Berlese, we have a means of checking the increase of these fruit flies by spraying here and there with a sweet poisoned mixture to kill the flies and so prevent egg-laying and the consequent destruction of the fruit.

THE CHERRY FRUIT FLY.

(*Rhagoletis cerasi*. Linn.)

This serious cherry pest on the Continent is recorded by Verrall as British. Whether or not it is a true native insect we do not know, or whether the record is purely from the presence of the maggot of this fly in imported fruit. In any case growers know nothing of it, and no one seems to be able to obtain authentic British records, that is, finding the actual creature breeding in this country.

A short description is appended owing to its serious depredations on the Continent and the too frequent importation of infested cherries into this country. Fortunately, we do not peel or cut cherries in two; the result is that the maggots, as a rule, are eaten with the cherries. This, if nasty, is to the benefit of the home grower.

The fly, which is common in the warmer parts of Europe, can at once be told by its wing markings.

It appears in May, June and onwards. The female punctures the skin of the cherry obliquely and lays her egg in the flesh; some say near the stalk, and that the maggot penetrates into the fruit on hatching. The egg is white and elongate, about 0·02 inch long, somewhat broadened towards one end. A distinct scar marks where the egg has been laid. The incubation lasts but a few days. The maggot is creamy-white, quite footless, pointed towards the head end, where are two small processes above, two larger ones below; the tail end is truncated. In length it reaches nearly $\frac{1}{3}$ inch. Their abode is the flesh of the cherry, where they burrow around the stone for three or four weeks. They are usually mature about the time the cherries are ripe and in the consumers' hands. Attacked fruit shows, as a rule, a brown discoloured patch on one side. Attacked fruits do not seem always to fall, but in all cases the maggots leave them and pupate in the ground, in a brown puparium case with two short horn-like points at each end.

These puparia may also be found at the bottom of baskets, boxes, etc., in which the cherries are sent to this country, and also amongst rubbish.

It is said that the maggots are not found in fruits with acid pulp, such as Hortense, Reine, Montmorency and Royale, but especially occur



[F. Edenden.]

FIG. 319.—WING OF CHERRY FRUIT FLY.
($\times 9.$)

in Whitehearts and Bigaroons. They do not occur in the "Guigne à collier," grown in Normandy, nor in the wild cherry.

Should this insect, which may be British, but which in any case is very rare, and which is imported in foreign fruit, become noticeable in any plantation or garden, it would be wise to forego any crop by having all the fruit destroyed to prevent damage another year and the possible spread to other plantations near, and so, perhaps, over the whole southern part of the country.

THE JAPANESE OR WEST INDIAN FRUIT SCALE.

(*Diaspis pentagona*. Targ.-Tozz. = *Diaspis amygdali*. Tryon.)

Although, as far as we know, this insect is not found in Britain to-day, we must not overlook the fact that it has been imported and has lived here.

Newstead (1) quotes its appearance at Kew in March 1898 on *Prunus pseudo-cerasus*, on plants imported from Japan which had been out of doors since January in the same year. Again (2), in 1899, he says: "In January of the present year a consignment of several hundred Japanese cherries (*Prunus pseudo-cerasus*) was imported into this country from Japan which ultimately fell into my hands, and were disseminated over the British Isles without any knowledge that they were badly infested with the scale. In the following April two of the plants from the consignment were sub-

mitted to the writer for the purpose of identifying the insects upon them, which proved to be the destructive scale insect *Diaspis amygdali* of Tryon. On inquiry it was found that the greater number of the plants of this particular batch (100) had been planted out of doors since the time of arrival, and the examination proved the insects were not in any way affected by their change of climate, but appeared in a perfectly healthy condition." Later, June 3rd, the insects were still found living, so the plants were burned. Some plants do not appear to have been traced. Enough was seen, however, to show that the insect can live in the open in England.

As the Japanese cherry is often imported to this country, it is very



[F. Edenden.]

FIG. 320.
JAPANESE FRUIT SCALE (*Diaspis pentagona*).

necessary that this pest should be kept in view, as it is one that is very serious in other countries. In fact, plants should not be allowed free import in this way without inspection, or this serious pest may some day be spread far and wide over the country, adding another to the already many troubles of the British fruit-grower.

It is known in Africa as the White Peach Scale or Peach Diaspis (5).

DISTRIBUTION.

Fernald (3) gives the distribution as follows:—England, Switzerland, Italy, New Zealand, Ceylon, Australia, Hawaiian Islands, Japan, China, South Africa, Mauritius, Brazil, West Indies, Panama, Massachusetts, Washington, Ohio, Georgia, Florida, California.

Lounsbury (5) gives also the Cape and Fiji.

FOOD PLANTS.

Peach, plum, cherry, apricot, walnut, grape, mulberry, geranium, hibiscus, etc. (4). Newstead says it also occurs on the dwarf flowering almond and tea bushes in Japan. Green says it is very prevalent on pelargoniums in Ceylon.



FIG. 322.—*Diaspis pentagona* (?).
From Mulberry.
(Greatly enlarged.)

fixed body of the female undergoes its transformations, lays its eggs, and dies (Figs. 322 and 323).



[F. E.
FIG. 321.
JAPANESE FRUIT SCALE (*Diaspis pentagona*) on Mulberry.

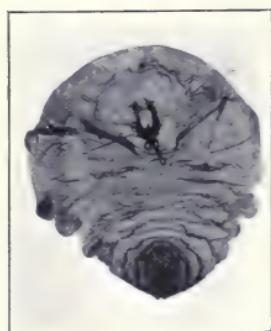
LIFE-HISTORY, ETC.

I have not seen any British specimens of this pest, so give Newstead's account *verbatim* (2): "To the unaided eye the scale or covering shield of the female is more or less circular, and closely resembles the common rose scale (*Diaspis rosæ*), but is of a dusky white, the old examples being smoky grey or ochreous, and harmonising with the colour of the bark. They are the size of an ordinary pin's head, and measure from 1 to 2 mm. Beneath this scale the wingless, legless, inert,

"For the purpose of identification it will be necessary briefly to describe the salient characters of the female, which alone affords us the means by which we can separate it from the numerous allied species belonging to the same sub-family."

"The covering scale of the male is pure white, narrowly elongated, and much smaller than that of the female. Within this covering, which somewhat resembles the finger of a glove, the insect undergoes its transformation, appearing in due season as a very tiny two-winged fly having an orange coloured body." The male scales are often densely massed on the branches together and make them look as if whitewashed.

Lounsbury (5) describes the female scale as being nearly circular, with an orange-yellow spot midway between the centre of the scale and the front margin, and says that old scales and those fully exposed are quite grey, but on the fruit, and when sheltered by the buds, the colour is almost white. The situation makes some difference in the rotundity of the scale and in its form.



[F. Edenden.]

FIG. 323.—*Diaspis pentagona* ♀.
Jamaica (Geranium).
(Greatly enlarged.)

As no one but the specialist can identify these scale insects, it would be best if the grower is in doubt to send them to Mr. Newstead at the University, Liverpool, or to myself. The female scales remain long on the trees after death. The female insect under the scale is pink. About 150 eggs are laid by each female. The young are pink, and then become covered with a coat of loose white waxen woolly threads. There may be three generations per annum in America, as many as four at the Cape.

Lounsbury describes a reddish discoloration around the scales when on the fruit. In South Europe it is a great pest on the mulberry.

TREATMENT.

If it occurs in this country again, the best plan is to fumigate the stock at once with hydrocyanic acid gas or burn it. It is an extremely difficult insect to destroy. Resin wash and lime, salt and sulphur washes appear to do most good as spray fluids.

NATURAL ENEMIES.

Numerous ladybird beetles feed on this scale insect in different countries. At the Cape a Two-spotted Ladybird (*Chilocorus distigma*, Klug) and its larvae seem to do some good. A Chalcid Fly (*Aspidiophagus citrinus*, Craw) also infests the scale in Cape Colony.

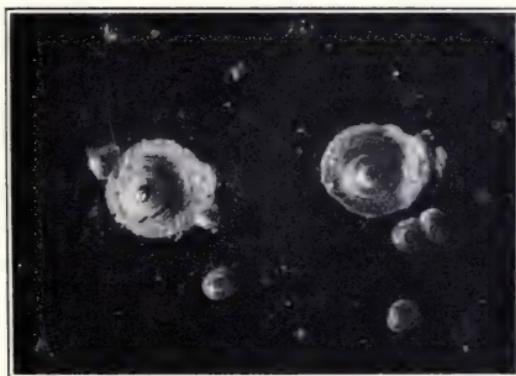
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- (1) Newstead, R. 'A Monograph of the British Coccidae,' vol. I., p. 175 (1901).
- (2) Newstead, R. The Injurious Scale Insects and Mealy Bugs of the British Isles. Journ. Roy. Hort. Soc., XXIII., pt. 3 (1899).
- (3) Fernald, M. E. 'Catalogue of the Coccidae of the World,' p. 234 (1903).
- (4) Fernald, M. E. Canadian Entomologist, vol. XXX., p. 79, and Bulletin Bot. Dep. Jamaica, p. 257 (1896).
- (5) Lounsbury, C. P. Report of the Government Entomologist for the year 1896, p. 76 (1897).

THE SAN JOSÉ SCALE.

(Aspidiotus perniciosus. Com.)

This pest is by far the most pernicious of the many insect enemies fruit-growers suffer from abroad. It was apparently introduced into



[E. P. Felt.]

FIG. 324.—SAN JOSÉ SCALE (*Aspidiotus perniciosus*).
On apple. (x 8.)

America from Japan, and it has flourished and spread to an alarming extent. Its native home is China. It was imported into California in 1870. It first became injuriously abundant three years later at San José, hence its popular name. It spread in twelve years throughout all California, Oregon, and into Washington State, and has since gradually extended its range until now we may say it is found in all the States lying south of the great lakes. In Australia it is found in several parts of New South Wales, in Victoria and South Australia. Mr. Froggatt states that it "has been in existence in New South Wales and some of the other Colonies for many years. As far as I can learn it has been looked after and checked, if not stamped out, both in Victoria and South

Australia."* It was introduced into Sydney from California on apple and pear stocks by a nursery firm. Its distribution, given by Mrs. Fernald ('A Catalogue of the Coccidae of the World,' p. 275, 1903), is as follows:—Canada, United States, Chili, Germany, Australia, Japan, China, Hawaiian Islands.

PLANTS AFFECTED BY THE SAN JOSÉ SCALE.

Mr. S. J. Hunter, M.A., in an article † states that this scale attacks nearly all fruit trees and fruit-bearing shrubs, mainly rosaceous trees and bushes. Professor Webster gives the following as being attacked by *A. perniciosus* ‡:—Black Walnut (*Juglans nigra*), Caroline Poplar (*Populus deltoides*), Lombardy Poplar (*P. nigra-italica*), Golden Leaf Poplar (*P. deltoides aurea*), European Willow (*Salix verinalis*), American Chestnut (*Castanea dentata*), Elm (*Ulmus americana*), Osage Orange (*Toxylon pomiferum*), Gooseberry (*Ribes uva-crispa*), Currant (*R. rubrum*), Cotoneaster (*Cotoneaster frigidum*), Japan Quince (*Pyrus japonica*), Rose (*Rosa spp.*), Flowering Peach (*Prunus persica*), Flowering Cherry (*P. avium*), Sumac (*Rhus glabra*), Grape (*Vitis labrusca*), American Linden (*Tilia americana*), European Linden (*T. europea*), Hardy Catalpa (*Catalpa speciosa*), and Mountain Ash (*Sorbus americana*).

Mr. Howard § gives Apple, Crab Apple, Pear, Bartlett Pear, Duchess Pear, Plum, Japan Plum, Satsuma Plum, *Prunus pissardi*, *P. maritimi*, Peach, Apricot, Almond, Black Currant, *Citrus albopanetus*, the Loquat, Red Dogwood, June Berry, etc. Professor Lintner || also gives the following food plants:—*Acacia*, *Euonymus*, *Spiraea*, *Crataegus*, Persimmon (*Diospyros*), Alder (*Alnus*), and the Laurel-leaved Willow of Asia. Howard and Marlatt ¶ also mention amongst others, the Raspberry. Lastly, Mr. Maskell ** records it on the Gum Tree (*Eucalyptus corynocalyx*) from Adelaide, South Australia.

Many others may be added (*vide* Fernald, 'Coccidae of World,' p. 275, and Rept. Conn. Exp. Sta., 1902, p. 132, 1903).

APPEARANCE OF THE SCALE.

The scale is round (sometimes *very slightly* elongated), flat, and applied close to the bark, leaf or fruit of the tree, resembling to some extent the bark of the twigs in colour. At or near the middle of each scale is a

* Agri. Gazette of N. S. Wales, Dec. 1897, p. 874.

† Bull. Dept. Ento. Univ. of Kansas (Scale Insects), p. 9 (1898).

‡ Bull. 81. Ohio Agri. Exp. Station, p. 184 (1897).

§ Tech. Series, No. 6. Washington Dept. Entomology.

|| Eleventh Rep. State Ento. New York State, p.

¶ Bull. San José Scale. 3. Dept. Agriculture U.S.A., p. 38 (1896).

** Trans. New Zealand Institute, vol. XXVIII., p. 386 (1896).

small, round, slightly elongated nipple, arising from a depressed surface; sometimes this point is brown or black, at others yellow in colour.

The female scale is circular and varies in diameter from $\frac{1}{25}$ to $\frac{1}{8}$ inch. The cast skins of the larva are central, the fully-formed scale is mottled grey, except over the central exuviae, where the colour varies from pale to reddish-yellow, but in some it is dark brown. The scale is usually smooth but sometimes slightly annulated.

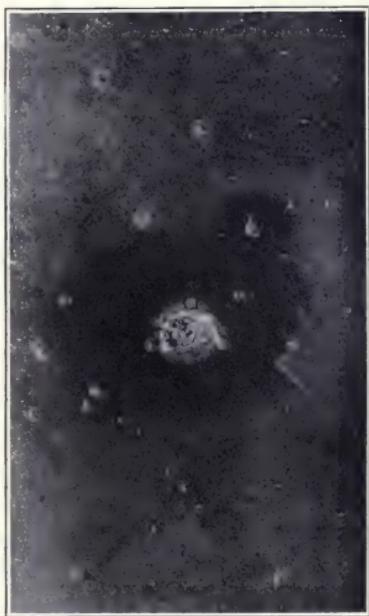
The male scale is oblong, nearly twice as long as wide, from $\frac{1}{40}$ to $\frac{1}{6}$ inch long; there is a nipple-like prominence between the centre and the anterior margin of the scale. The male scale is darker than the female, sometimes almost black, but the larval scale covering the exuviae is often light yellow as in the female. Often the central larval scale is black and the additions grey. The immediate coverings are dull yellowish-grey.

These scales congregate thickly on the bark, overlapping one another, and are often covered with a black sooty fungus (*Fumago salicina*). The scales being so minute single specimens may easily escape detection, but when present in numbers the grey colour shows up on the bark clearly. "Trees seriously infested," Mr. Fletcher* says, "look as if dusted with lime or ashes." It is found at the end of the branches and twigs in the pear, but on peach it attacks the older parts as well. Upon young growths the scale is surrounded by a narrow reddish band, especially around the female scale. On young twigs, Hunter notices that the layer of tissue between the outer bark and wood proper becomes dark red or purplish, the rings often being most striking.

On the leaves the scales are found in one or more rows upon the upper side of the mid rib. Infested leaves turn purplish-brown.

The fruit is frequently attacked and becomes rough and pitted. On pears we may always detect this scale by the reddish discoloration round the scale.

* Twenty-fifth Annual Rept. Ento. Society of Ontario, p. 74 (1894).



[E. P. Felt.
FIG. 325.—SAN JOSÉ SCALE. ($\times 5$.)

LIFE-HISTORY.

This insect in America passes the winter in either an immature or nearly mature state, protected by its scale. In the late spring the female reaches maturity and the male comes forth as a two-winged insect. The winged male is orange in colour, with a dusky-brown prothorax, brown transverse band on the thoracic shield, and purple eyes; the wings are dusky, iridescent with yellow and green; it has a long anal style, dusky brown in colour. The females, having been fertilised by the winged male, commence to produce young. Eggs are not laid by this species as a rule, but young are produced direct. The female continues to give birth to young for six weeks and then dies. It is generally believed that this insect is always viviparous, but Riley, Matthew Cook and Klee state that white or yellow ovate eggs are also laid. The young or larvæ are minute active six-legged creatures, orange in colour, and about $\frac{9}{1000}$ inch long. When they crawl forth from under the female scale they wander about upon the trees for some little time, and then fixing their long proboscides into the plant remain sedentary and soon commence to form a waxy covering or scale. At first this scale is white and fibrous (Howard). In two days the larva is said to become invisible, being covered with a pale greyish-yellow shield, with a projecting white nipple in the centre. In this stage both male and female scales are alike, but about twelve days later the larva undergoes the first moult, when the scales of the two sexes become distinct. Both immature male and female beneath the scale will be seen to have lost their legs and antennæ, the females their eyes, but the males have large purple eyes. About eighteen days after birth the male enters the propupal stage, in which a new set of legs, etc., become formed, and six days later the winged male hatches out. The females keep sedentary and reach maturity about thirty days after birth and give rise to young about a week later. At least five generations occur in the year in America, if not more.

RATE OF INCREASE.

This pest increases with extraordinary rapidity in America. Experiments conducted by the Department of Entomology at Washington have proved beyond doubt that a mature female produces nine to ten young every twenty-four hours for six weeks, making a total of 400 individuals from one insect. From accurate observations in connection with these experiments it was estimated that one winter female will give rise to a progeny of 3,216,080,400 in one year under the most favourable conditions.

NATURAL AND ARTIFICIAL DISTRIBUTION.

The San José, like other scales, can be distributed in a number of ways from tree to tree, orchard to orchard, and country to country.

Since the larvae only can wander about, and these for a comparatively short distance, their distribution can only take place by outside agencies to any appreciable extent. The larval scale insects are no doubt blown about by the wind, especially such as are of a woolly nature, but *Aspidiotus perniciosus* also is disseminated in that way. That birds and various insects carry scale larvae from tree to tree and even over considerable distances is a well established fact. Amongst insect distributors have been noticed ants, upon which the young scale larvae have been seen. They have also been seen upon the wing covers of ladybirds.* The main distribution of scale insects is on nursery stock and ornamental plants. No more potent means of distribution exists. In nearly all cases the introduction into various States in America of this pest has been traced either to imported nursery stock or to infested cuttings. Should any such stock be obtained from any of the American States or other parts where the San José scale exists they should be subjected to a complete examination and fumigation. Fruit, especially pears from infested areas, also carries the scale, and from this way we must partly guard against its introduction into this country.

A way in which we might obtain this *Aspidiotus* is by the scales attached to the imported fruit being thrown with the skin of the pear near some fruit or other tree, when the young hatching from the gravid females might easily ascend and set up a colony from which numerous other areas might receive the disease by various natural agencies.

But the chance, it seems, of the disease spreading from infested fruit is very slight. Professor Webster says †: "While there is a certain amount of danger from this source, yet up to the present time not a single instance has been recorded where infections from this source could even be suspected. So far as known to me, every outbreak of this scale has been traced to nursery stock."

There is certainly some risk that these infested fruits, finding their way into the country, may enable the disease to get a foothold in our orchards and hothouses. But it is especially on imported plants, both fruit and ornamental, that we must keep watch.

THE PROBABILITY OF ITS INTRODUCTION AND SPREAD IN ENGLAND.

That the San José scale is sent to this country there is no doubt, a very meagre and cursory examination having revealed its presence on pears. It is, of course, very difficult to say whether the imported insects if they reached our fruit trees would stand the rigours of our climate. But judging from the history of other species, we know that some can withstand very great differences of temperature. We cannot, in fact, rely

* Eleventh Report of New York State Entomologist, p. 224, Lintner.

† The San José Scale in Ohio Bull. 21, Ohio Agri. Exp. Station, 1897, p. 192.

upon climatic barriers in regard to the Coccidæ. As Mr. Cockerell * says : "it is probable that the very rapid reproduction of Coccidæ enables them to quickly adapt themselves to changes of climate, through survival of the fittest. Thus if there are a million scales in an orchard which is touched with frost, if only one gravid female survives it will suffice to eventually re-stock the orchard and with a comparatively frost-proof race." This authority gives as an example the Peach Scale (*Diaspis amygdali*), which flourishes equally in Washington and in the tropics. We must remember we have found the last-named breeding here. Moreover, the scale insects are so erratic in their behaviour in any new country into which they are introduced that it is quite impossible to predict the results of their introduction.

Although it is extremely unlikely that we shall suffer from its introduction, it is nevertheless advisable, when we take into consideration the peculiar circumstances of the case, that all fruit-growers and gardeners should be able to detect this scale, of which Professor Webster says :— "Of all scale insects at present known in America, this is the most to be feared on account of its deadly effects on the trees, the rapidity with which it increases, and the difficulty of killing it." One of our chief authorities on scale insects in this country, Mr. Newstead, said at a meeting of the Entomological Society of London, that there is no reason to suppose that it would be more injurious in this country than the Mussel Scale (*M. pomorum*), since in this country it would probably conform with the habits of all other scale insects and become single brooded. But in orchards we find the Mussel Scale often most injurious to apple trees, especially young stocks. We must not overlook the fact that it has also occurred in Germany.

OTHER SCALES MIGHT BE MISTAKEN FOR *A. perniciosus*.

It is extremely difficult to identify the San José scale from amongst the other thirty odd species of the genus *Aspidiotus*, when the scales are detached. But when present on the fruit and bark they can easily be told by an expert by the changes produced on the plant tissues around and beneath the scales and by their microscopic structure.

A common scale met with in greenhouses is *A. nerii*, the Oleander or White Scale—its snowy whiteness will distinguish it from *A. perniciosus*. The common Camellia Scale (*A. camelliae*) is similar in form but yellow when fresh, and on tearing away the upper scale a pure white under-scale is seen closely adhering to the under surface. In all cases an expert's advice should be sought before we imagine we have *A. perniciosus*, and we are sure that great authority, Mr. Newstead, of the School of Tropical Medicine at Liverpool University, would gladly help any grower in settling the question.

* 'On the Danger to American Horticulture from the Introduction of Injurious Insects,' New Mexico (1897).

B.—BENEFICIAL INSECTS.

Little notice has been drawn to the many insects which can only be looked upon as beneficial on account of their tending to keep down an access of other insect life. After many years' observations the writer is inclined to believe that they are quite competent to keep the balance of Nature but are quite incompetent to restore that balance of Nature upset by man. One or two cases of the benefit of such introduced "friends" are known, such as the cushion scale and the Vedalia ladybird one hears so much of, and which seems to have been made a jumping-plank for anyone to write and talk about.



[F. Edenden.]

FIG. 326.—APHIS DESTROYERS.

- 1, *Syrphus ribesii*; 2, *Catabomba pyrastris*; 3, *Syrphus balteatus*; 4, pupa of Ladybird Beetle; 5, *Coccinella 7-punctata*; 6, *Chrysopa perla*.

Some references have been made in this work to what Mr. Froggatt and Mr. Lounsbury in their travels have seen of these wonders in other countries, and this must surely settle the minds of any of the blind followers of the wonderful powers of insect friends. As Mr. Froggatt told me, when one wanted to see the working, for instance, of the introduced Codling Moth parasite in California, they were unable to show it him in the field.

That some insects prey upon others, every grower knows. When his fruit has been spoiled by aphid, and his hops blighted by the same, swarms



[F. Edenden.]

FIG. 327.—EGGS OF LACE-WING FLY (*Chrysopa*).
(Slightly enlarged.)



[F. Edenden.]

FIG. 328.—PUPÆ OF LADYBIRD BEETLES ON HOP LEAF.

of friends appear, but as the damage has been done it is not much to be thankful for. Next year we get just as bad an attack, if climatic conditions have been favourable to the increase of the many which escape their natural foes.

The chief insects that we may call friends in Britain are the Lady-birds (*Coccinellidæ*), the Ichneumon and Chalcid Flies (*Ichneumonidæ*, *Braconidæ* and *Chalcididæ*), the Lace-wing or Golden Eye Flies (*Chrysopidæ*), the Hover Flies (*Syrphidæ*) and the Tachina Flies (*Tachinidæ*), some of which are shown in the figures given here.

There have always been these parasitical and insectivorous insects; there have always been other insects causing endless loss to the fruit-grower, and he knows full well in this country, where fruit-growing knowledge is far in advance of any other, that they are no remedy for such ills, and can scarcely be considered palliatives, and one can only regret to see sums of money being wasted in such matters elsewhere. Man must destroy his enemies, and it is useless to rely on Nature to do so for him.

C.—WASHES AND FUMIGANTS USED AS INSECTICIDES AND ACARICIDES.

There are a great number of washes used for the purpose of destroying insects, either acting directly or indirectly. Many of these have been used in a haphazard way and have no scientific status.

At present we know little about this subject, and it was not until the Duke of Bedford and Mr. Spencer Pickering undertook the scientific investigation of this important matter at Woburn that anything of scientific and practical importance had been done. The result of their work in a few years has been that the knowledge of insecticides in this country has passed far ahead of that of America or any of our Colonies, where previously we had to gain most of our knowledge.

There may still have to be made some radical changes in the past unscientific, but often very successful, treatment of this subject. For instance, the writer at present cannot see, after twenty-five years' work, that the metal emulsions are competent to deal with all caterpillars, but further experiment may prove that, made with solar distillate, they are just as useful as the more dangerous arsenical sprays. Even then we may have to consider the injurious effects of paraffin on the health of fruit trees as compared with the comparative harmlessness of arsenate of lead.

The importance of such vegetal insecticides as tobacco is one that we must keep well to the fore, for after many years of experimenting and observations, the writer has never seen, even when the trees are in

blossom, the least harm done by it, and the insecticidal value is very great.

The one thing growers have to guard against is the unscrupulous throwing on the market of patent washes, usually made and boomed by people who do not seem to fully appreciate the harm they may be doing. The more such things are boomed the less we usually find in them. When we see a wash or so-called "spray fluid" being forced upon us that will cure all the diseases, insect and fungoid, then we may rest assured that its marketable value is very low.

Growers may spend much too much on the spraying of their plantations, a costly procedure, when many of these washes are merely experimental, and will be for many years to come, for the subject is only just at its birth. It is well that they should go cautiously.

As far as we can say at present, winter-washing is of use mainly as a means of cleaning the trees, and need not be done more than once every three or four years in a good plantation, unless in very damp localities. No wash has yet been found of any service in destroying insects' eggs, nor is likely to be in the near future.

The grower should aim at destroying the young insects by washing in early spring with an arsenical and contact wash, such as arsenate of lead and paraffin, and with this can be added the fungicide Bordeaux mixture; this should be done again after the blossom has fallen. Any subsequent treatment must depend on any particular attack.

Gooseberries and currants may be sprayed in late winter with paraffin jelly wash or liver of sulphur and paraffin to cope with red spider, scale and fungus, and again later. Special attacks need to be treated specially.

No one remedy is likely to prove effectual to all, any more than one human dose will cure all man's ills.

One point is often neglected, and that is, that we must see to the general health and nutrition of our trees grown under unnatural circumstances, for healthiness will help a lot to combat disease.

Trapping, destruction of egg-masses (on prunings), and the employment of poultry or pigs in plantations, as circumstances permit, are other things we must not neglect. Lastly, the cultivation and development of varieties least subject to disease and most suited to the district should be a point to carry foremost in our work in combating plant pests.

The spraying of fruit trees is essential, but it will only do *some* good, and may exceed in cost the net results gained unless carried out in a careful manner and unfettered by quackery.

As far as insects go it must be looked upon purely as remedial and not preventive.

CAUSTIC OR WINTER WASHES.

CAUSTIC ALKALI WASH.

FORMULÆ.

(1) Caustic Soda (70 p.c.)	.	.	.	.	.	1 lb.
Carbonate of Potash (80 p.c.)	.	.	.	.	.	1 lb.
Soft Soap.	.	.	.	.	.	$\frac{1}{2}$ lb.
Water	.	.	.	.	.	10 gallons.
(2) Soda Crystals (Soda Carbonate, 98 p.c.)	.	.	.	.	.	$2\frac{1}{2}$ lbs.
Potassium Carbonate (80 p.c.)	.	.	.	.	.	1 lb.
Lime (fresh burnt)	.	.	.	.	.	$2\frac{1}{2}$ lbs.
Soft Soap (8 p.c. potash)	.	.	.	.	.	$\frac{1}{2}$ lb.
Water	.	.	.	.	.	10 gallons.

The above are the old formulæ. Spencer Pickering has shown that caustic soda is alone necessary, the formula reading as below :—

Caustic Soda (98 p.c. purity)	.	.	.	.	2 to $2\frac{1}{2}$ lbs.
Water	.	.	.	.	10 gallons.

PREPARATION.

(1) Dissolve the caustic soda and carbonate of potash in water and then add the dissolved soft soap.

(2) Shake the lime in a little water, and then add enough water to make it into a milk of lime (about $1\frac{1}{2}$ gallon of water). In this dissolve the soda and potash, and then dissolve the soft soap in the rest of the water and pour into the lime water.

A considerable excess of lime is advised to ensure the soda and potash being converted into the caustic state. This is Strawson's formula.

USES.

For cleaning old, mossy, and rough barked trees in winter, and to some extent killing mussel scale ova and soft scales.

WOBURN WINTER WASH (A).

FORMULA.

Iron Sulphate	.	.	.	.	.	$\frac{1}{2}$ lb.
Lime	.	.	.	.	.	$\frac{1}{2}$ lb.
Caustic Soda	.	.	.	.	.	2 lbs.
Paraffin (Solar distillate)	.	.	.	.	.	5 pints.
Water	.	.	.	.	.	10 gallons.

PREPARATION.

Dissolve the iron sulphate in 9 gallons of water ; slake the lime in a little water, and then add more, so as to make it into a milk of lime ; then run the milk of lime into the dissolved iron sulphate through a fine sieve to strain off all grit ; then churn the paraffin into the iron sulphate and lime, and finally add the caustic soda.

USES.

This wash acts as a great cleanser of the trees, removing moss, lichens, algae, etc. It also kills the delicate ova of the mussel scale.

TIME OF APPLICATION.

Any time between November and February.

WOBURN WINTER WASH (B).

FORMULA.

Copper Sulphate	1½ lb.
Lime	½ lb.
Paraffin (Solar distillate)	5 pints.
Caustic Soda	2 lbs.
Water	10 gallons.

PREPARATION.

Dissolve the copper sulphate in 8 or 9 gallons of water, slake the lime in water and add to the dissolved copper sulphate, running it in through a fine sieve to strain off all grit ; then add the paraffin and churn, and then add the caustic soda and add any water to bring the whole up to 10 gallons.

USES.

This wash acts as a cleanser of moss and lichens ; it also is fungicidal, and is of value where apple scab occurs on the wood. The mussel scale ova are also destroyed, and also oyster-shell bark lice. The copper sulphate is not necessary except where apple scab occurs on the wood.

TIME OF APPLICATION.

Any time between November and February.

LIME AND SALT WASH.

FORMULE.

(1) Lime	1 to 1½ cwt.
Salt	30 to 40 lbs.
Water	100 gallons.
(2) Lime	1 to 1½ cwt.
Salt	30 to 40 lbs.
Waterglass	5 lbs.
Water	100 gallons.
(3) Lime	1 to 1½ cwt.
Salt	30 lbs.
Washing Soda	3 lbs.
Water	100 gallons.

PREPARATION.

Get fresh lime of the best possible quality (flare lime is found to be the best) and let it slake gradually, and then mix it with the water in which the salt has been dissolved and strain through fine sieves or sackings into another receptacle. Waterglass has been added to make the wash hold better on the trees, but it is not essential, and does not always seem to have sufficient effect to make the extra cost worth while.

If it or the soda is added, it should be put in the strained wash, having been previously dissolved in water.

USES.

For the prevention of hatching of the eggs, of apple sucker, plum aphid, and also for cleaning the trees of moss, lichens, etc.

TIME OF APPLICATION.

The end of February until the beginning of April. Spraying should cease as soon as the buds open.

LIME-SULPHUR-SODA WASH.

FORMULA.

Lime	3 lbs.
Sulphur	3 lbs.
Caustic Soda	1 lb.
Soft Soap	1 lb.
Water	10 gallons.

PREPARATION.

Make the flowers of sulphur into a paste, and then thin and pour over the lime; let this boil for a quarter of an hour, then stir and add

the caustic soda; let this boil for some time, and then add the dissolved soft soap and full quantity of water.

LIME-SULPHUR-SODA-SALT WASH.

FORMULA.

Quicklime	3 to 6 lbs.
Sulphur	3 lbs.
Salt	3 lbs.
Caustic Soda	1 lb.
Water	10 gallons.

PREPARATION.

Mix the soda and lime together and slake with some hot water, in which the sulphur has been incorporated, and then bring up to the full 10 gallons. This mixture is also self-boiling.

USES.

For destroying the pear-leaf blister mite and as a scalicide.

APPLICATION.

On dormant wood only. In case of the pear, spraying must cease as soon as the bud scales are fully opened. A heavy spraying is best.

ARSENICAL WASHES FOR MANDIBULATE INSECTS.

ARSENICAL WASHES.

A. ARSENATE OF LEAD.	|	C. CALCIUM ARSENATE.
B. PARIS GREEN.	|	D. LONDON PURPLE.
E. ARSENITE OF SODA.		

A. Arsenate of Lead.

FORMULÆ.

(1) Arsenate of Soda (pure or crystalline)	. . . . .	3½ oz.
Acetate of Lead . . . . .	. . . . .	7 oz.
Water . . . . .	. . . . .	10 gallons.
(2) Arsenate of Soda (dry)	. . . . .	2 oz.
Acetate of Lead . . . . .	. . . . .	7 oz.
Water . . . . .	. . . . .	10 gallons.

PREPARATION.

Dissolve both together in the water and well stir and then add 1 lb. of treacle.

This insecticide may be obtained as a paste called Swift's Arsenate of Lead Paste and in other paste forms.

USES.

It destroys all biting-mouthed insects, such as caterpillars and beetles, especially beneficial for Winter Moth, Codling Moth, Lackey Moth, Currant Moth, Gooseberry and Nut Sawflies, Slugworm, etc.

This wash may be mixed with Bordeaux mixture and also paraffin.

TIME OF APPLICATION.

The first spraying should take place as soon as the buds show signs of bursting and again as soon as the blossom has fallen. Now and again a third spraying may be necessary to kill Gold Tail and Vapourer Moth caterpillars, etc. It should be used as a fine spray, and the spraying should cease as soon as the leaves are seen to be dripping.

B. Paris Green.

FORMULÆ.

(1) Powder :—

Paris Green Powder	1 oz.
Water	10 gallons.

(2) Blundell's Paste (Copper Oxide, 31 p.c., Arsenic Trioxide, 59 p.c., Acetic Acid, 10 p.c.) :—

Blundell's Paste	1 oz.
Water	10 gallons.

PREPARATION.

Mix either the powder or paste with the water and keep in constant movement to prevent the Paris green sinking to the bottom of the water. The writer has always found the addition of lime, at the rate of 4 oz. to the 10 gallons, of benefit in stopping scorching, but Strawson says this is not necessary.

For delicate-leaved trees, such as peach, nectarine and apricot, $\frac{3}{4}$ oz. to 10 gallons is sufficient.

USES.

For destroying all biting-mouthed insects, such as caterpillars and beetles.

TIME OF APPLICATION.

The same as for arsenate of lead. It is necessary that this wash is put on as a very fine spray, owing to the scorching effect it has on foliage. It must never be used when the trees are in blossom.

C. Calcium Arsenate.**FORMULA AND PREPARATION.**

Add one part milk of lime to every one part of crystallised sodium arsenate dissolved in 400 to 500 parts of water.

USES, ETC.

The same as the former.

D. London Purple.**FORMULA.**

London Purple	1 oz.
Lime	1 oz.
Water	10 gallons.

USES, ETC.

The same as the previous arsenical washes.

E. Arsenite of Soda.**FORMULA.**

White Arsenic	2 lbs.
Sal. Soda	8 lbs.
Water	2 gallons.

PREPARATION.

Boil until the arsenic is dissolved (about fifteen minutes) and keep up to 2 gallons by adding water. Use 1 pint of this to 40 gallons of water.

USES.

The same as above.

GENERAL NOTES ON ARSENICAL WASHES.

Of the five mentioned there is no doubt that arsenate of lead is best to use, because of its being more easily mixed and holding in suspension longer than Paris green, etc., and in the almost entire absence of burning the foliage if properly mixed; it has also more adhesive properties.

The paste form known as Swift's Paste has been found satisfactory in many parts of the world, and is best to use unless great care is taken in making the home-made wash.

Fruit trees should not be sprayed with these arsenical washes when in flower, as the bees are so readily poisoned, and they should not be sprayed for at least four weeks before the fruit is gathered. This is a point we must remember when gooseberries and currants are growing beneath apple and plum.

These arsenical washes should be put on in as fine a spray as possible.

Animals may be kept in the grass orchards when the trees are sprayed, as long as they cannot get at the actual wash.

All receptacles in which the arsenical wash has been mixed should be cleaned and kept away from stock.

We must remember that these washes, especially when concentrated, are deadly poisons.

Arsenate of lead is generally used in conjunction with Bordeaux mixture, and it also emulsifies paraffin, so that we can combine a fungicide and an insecticide for mandibulate and haustellate insects in one.

PARAFFIN EMULSIONS OR CONTACT WASHES FOR HAUSTELLATE INSECTS.

PARAFFIN EMULSIONS.

For winter application these washes may be used very strong, but for summer use they must be much diluted.

Except in bad attacks of scale insects they cannot be recommended for summer use, nor paraffin in any form.

In spring it may be used for red spider on gooseberries in the form given under Paraffin Jelly, but it is best to apply it before the leaves are showing, as even the finest oils do harm to vegetation.

Through the work of Mr. Spencer Pickering we now know more of these matters, and growers will do well to use the oil recommended by him, known as Solar Distillate.

The usual form of paraffin emulsion is soap emulsion, but Mr. Pickering has recently shown that metal emulsions are superior as emulsions. Probably for scale insects the metal emulsions will soon supersede the soap emulsions, but for aphides they are not likely to do so, as the soap is an active killing agent, holding on to the mealy skin and is alone sufficient to destroy them.

A. Soap Emulsions.

The Riley-Hubbard formula is also given here, but the emulsions I have used have been the following:—

FORMULÆ.

(For Winter Use only.)

(1) Paraffin (White Rose).	.	.	.	.	.	1 gall.
Soft Soap .	.	.	.	.	.	1½ lb.
Water .	.	.	.	.	.	10 gallons.
(Summer Use.)						
(2) Paraffin .	.	.	.	.	.	4 pints.
Soft Soap .	.	.	.	.	.	1½ lb.
Water .	.	.	.	.	.	10 gallons.

PREPARATION.

The soap is dissolved in boiling water, and when still very hot (better still just boiling) the paraffin is added and the whole churned by means of a force pump into a creamy mass.

The Solar Distillate oil is undoubtedly the best to obtain, but excellent results have been obtained with Tea Rose and White Rose oils.

USES.

For the destruction of mussel scale eggs in the winter, oyster-shell bark louse and brown currant scale; for aphidæ, etc., in summer.

No effect on insect eggs.

Riley-Hubbard Formula.

FORMULA.

Paraffin .	.	.	.	.	.	2 gallons.
Boiling Water .	.	.	.	.	.	1 gall.
Soft Soap .	.	.	.	.	.	½ lb.

PREPARATION.

Dissolve the soft soap in boiling water, and when still boiling hot pour it into the paraffin and churn it into a creamy liquid.

Dilute for use one part of this emulsion with from ten to fifty times the bulk of water.

USES.

For destruction of scale insects and aphides.

TIME OF APPLICATION.

The strong solution when the trees are dormant, the weaker in summer.

Paraffin Jelly.

FORMULA.

Paraffin .	.	.	.	.	.	5 gallons.
Soft Soap .	.	.	.	.	.	8 lbs.

PREPARATION.

Boil the soft soap and the paraffin together and when boiling add 1 pint of cold water and stir well. This becomes a jelly on cooling; add 10 lbs. of this jelly to every 40 gallons of water.

USES.

For the destruction of red spider on gooseberry, and also for killing the brown scale on gooseberry and currants.

TIME OF APPLICATION.

In February if only for scale, in March if for red spider or for both.

B. Paraffin-Metal Emulsions.

FORMULÆ.

(*For Summer Use.*)

(1) Copper Sulphate	10 oz.
Lime Water	8 gallons, 3 pts.
Solar Distillate	24 oz.
Water	10 gallons.
(2) Iron Sulphate	10 oz.
Lime	5 oz.
Solar Distillate	24 oz.
Water	10 gallons.

PREPARATION.

Dissolve the copper or iron sulphate in water and add the lime water or lime, and then churn in the oil and bring up to 10 gallons with water.

USES.

The first acts both as a fungicide and insecticide, the second as an insecticide only. Aphides, leaf hoppers, thrips are destroyed by this wash, and according to Mr. Spencer Pickering's results caterpillars are also killed by it.

TIME OF APPLICATION.

Just when the buds are bursting and again when the blossom has fallen. Arsenate of lead may be mixed with either of these washes.

Apply as a fine spray.

QUASSIA AND SOAP WASH.

FORMULA.

Quassia Chips	1 lb.
Soft Soap	½ lb.
Water	10 gallons.

PREPARATION.

Boil the quassia chips in water for a couple of hours, then dissolve the soap in warm water, if possible, and mix the strained-off quassia extract with the soap.

Another method of preparation consists of boiling the quassia with half the soap and half the water, strain off the liquid and boil the residue for one hour with the rest of the soap and water, and mix the two decoctions and make up to 10 gallons of water.

USES.

For the destruction of all aphides and psylla.

TIME OF APPLICATION.

As soon as the aphides hatch from their eggs, or appear on the plants, if migrants; for psylla, when in the trusses of blossoms or when they are hatching.

VEGETAL WASHES.

These are particularly useful, on account of their being quite innocuous to the plants and at the same time have very powerful insecticidal properties.

There are three used, namely :—

- (1) Tobacco Wash.
- (2) Hellebore Wash.
- (3) Pyrethrum.

All three of these are also used as dry powders for dusting, but applied in liquid form they are found more successful. Tobacco and pyrethrum are also used as fumigants.

Tobacco Wash.**FORMULÆ.**

(1)	Tobacco Powder	3 lbs.
	Soft Soap	½ lb.
	Water	10 gallons.
(2)	Tobacco Leaf	½ lb.
	Soap	½ lb.
	Water	10 gallons.

PREPARATION.

Infuse the tobacco powder or leaf in water for about six hours, then strain off and press the tobacco and infuse again. Add the tobacco extract to the dissolved soft soap and water.

USES.

An excellent insecticide for aphis, psylla, cuckoo spit insects, leaf hoppers, and thrips. It is also to some extent a repellent or insectifuge, and for this purpose might be sprayed over unopened or opened blossom to prevent egg-laying by pear midge and apple sawfly. Nothing definite, however, can be said on this point.

It may be obtained in the form of a powder-tobacco, which has been denatured, in bond at 20s. per cwt., or if the leaf is used, any of the coarser tobacco will do, at about 3s. 6d. per lb. If powder is employed a much greater quantity is necessary than if the leaf, but the former, being so much cheaper, is recommended. Messrs. Voss and Co. send out a tobacco extract, 1 lb. of which equals 3 lbs. of tobacco and makes 10 gallons of wash.

TIME OF APPLICATION.

For aphis and apple sucker in early spring, best just after the buds have burst. For thrips, etc., in May and June. It may be used at any time even on opened blossom.

Hellebore Wash.(The root of *Veratrum album*.)

FORMULA.

Fresh Hellebore Powder	.	.	.	.	.	2 lbs.
Water	.	.	.	.	.	10 gallons.

PREPARATION.

Obtain the best fresh ground hellebore and merely mix it with water and keep constantly agitated.

USES.

For the destruction of all sawfly larvae.

TIME OF APPLICATION.

This varies according to the species of sawfly.

Pyrethrum Wash.(The flowers of *Pyrethrum* spp.)

FORMULA.

Pyrethrum	.	.	.	.	.	2 to 3 lbs.
Water	.	.	.	.	.	10 gallons.

PREPARATION.

Infuse the fresh powder in hot water for three or four hours, and then strain off and add to the full amount of water.

USES.

For all biting insects as a spray, and for all insects as a powder or fumigant.

TIME OF APPLICATION.

According to the appearance of the pest.

ACARICIDES.

LIVER OF SULPHUR.

(*Potassium Sulphide.*)

FORMULA.

Potassium Sulphide.	.	.	.	.	.	3 to 5 oz.
Water	.	.	.	.	.	10 gallons.

PREPARATION.

Dissolve the substance in water.

USES.

This is not only fungicidal, but is also an acaricide, and may be used on gooseberries for red spider. It may be mixed with paraffin. Its action is somewhat uncertain as an acaricide, however, and its place is being taken by paraffin jelly.

LIVER OF SULPHUR AND PARAFFIN.

FORMULA.

Iron Sulphate	.	.	.	.	.	2 oz.
Quicklime	.	.	.	.	.	1 oz.
Paraffin	.	.	.	.	.	16 oz. (liquid).
Potassium Sulphide	.	.	.	.	.	4 to 6 oz.
Water up to	.	.	.	.	.	10 gallons.

PREPARATION.

Dissolve the iron sulphate in 6 to 7 pints of water, and add to this the quicklime, made into a milk, passing it through a fine sieve to strain off any grit, and then emulsify the above with 16 liquid ounces of paraffin; then dissolve the potassium sulphide in 9 gallons of water and pour the emulsion into it and well mix.

USES.

This wash may be used in winter on bushes and trees attacked by scale, or in late winter on bushes attacked by red spider.

If used in the spring, half the quantity of potassium sulphide should be used.

FUMIGATION.

Two substances are used for the purposes of fumigation to kill insects on nursery stock. These are (1) hydrocyanic acid gas and (2) bisulphide of carbon.

The first-named has proved itself of great value, and abroad is used out of doors to fumigate fruit trees.

This is not necessary in this country, nor is it done by any fruit-growers.

The necessity of fumigating nursery stock before planting is now recognised by our most up-to-date growers.

In some of the Colonies, such as the Cape, all introduced stock is thus treated.

HYDROCYANIC ACID GAS.

The proportions of the chemicals used do not vary, but the quantity used of them per cubic foot of space depends on whether the plants are dormant or in foliage, whether they are deciduous or non-deciduous, and according to the variety of plant treated.

FORMULA.

Potassium Cyanide (98 p.c.)	.	.	.	1 oz.
Sulphuric Acid (sp. gr. 184)	.	.	.	1 oz.
Water	.	.	.	4 oz.

EXTENT.

100 to 200 cubic feet for dormant plants, 1,000 cubic feet for green plants.

PREPARATION.

Prepare an air-tight shed or glass-house of known capacity, then pile up the nursery stock to be fumigated. The sulphuric acid and water are then mixed together slowly by dropping the acid into the water, and this is put in an earthen basin. The cyanide is then allowed to fall into the sulphuric acid and water, and at once the fumes arise.

Specially constructed cheap apparatus are made for this purpose, so that the cyanide can be placed in the acid and water from outside the house, and thus exclude all risk of inhaling the deadly fumes. One of

the best I have seen is that made by Edwards, nurseryman, of Leeds. The stock should be left in the fumes for one hour, and then the fumigating shed well ventilated from above and allowed to clear itself of gas for some hours before the stock is removed.

The figures given here are for dormant nursery stock and for currant and gooseberry bushes in the ground during the winter and for vines. Treatment of large trees out of doors is troublesome and costly, and is not necessary in this country.

Recently I have found sodium cyanide far better than potassium cyanide, being stronger; but I have used the same proportions in fumigating apples and pears in winter. Pickering finds it best to use $\frac{2}{3}$ to $\frac{1}{2}$ oz. of potassium cyanide to 100 cubic feet or $\frac{1}{2}$ to $\frac{1}{3}$ oz. of the sodium cyanide, and to each ounce of either 1 oz. of sulphuric.

USES.

This gas is deadly to all forms of life. Not only are all the scale insects on fruit trees destroyed by it, but also their eggs, such as those of the mussel scale. Woolly aphid and all plant lice, etc., are killed, and so are the eggs of most insects (with regard to Lackey moth and one or two others we have no definite result, *vide* body of the work). The Board of Agriculture leaflet is wrong in stating that insects' eggs are not destroyed. It is well known that those of scale insects, aphides, winter moth, etc., are killed if the full strength given above is used.

TIME OF APPLICATION.

Before the stock is planted. It is best left a few days so as to get rid of too much moisture, and the rootage should as far as possible be cleaned of earth. For woolly scale insects on currant and gooseberry bushes in plantations, February is the best month to fumigate.

Vineries are best treated in the dormant season, and two fumigations will be found better than one very strong one, at two weeks' interval.

The temperature should not be more than 60° F., nor should the fumigation be carried out in a bright light.

Other information is given under Mealy Bug in vines (*see* p. 484).

BISULPHIDE OF CARBON.

This fumigant is little used for nursery stock. It is, however, of some benefit as a soil fumigant. The vapour coming from it being heavier than air, sinks into the soil and is fatal to all forms of insect life it comes in contact with.

Its effect in different soils and at different degrees of humidity is very varied, however.

It must be remembered that it is very inflammable and a poison, and has to be applied with some care. It will also damage rootage where it actually comes in contact with it, but the fumes are quite harmless to plant root tissue.

AMOUNT TO USE.

For fruit trees infested with root aphides, such as woolly aphis, currant root louse, use for apple trees, 4 oz. to each tree, for currants 1 oz.

This may be made in $\frac{1}{4}$ oz. injections all around the trees. It is effective for a radius of up to 20 inches.

Two injections are better than one; that is, use 2 oz. to an apple tree, then a week later another 2 oz. in the intermediate spaces.

The depth of injection best to follow is not yet definitely decided; it varies between 6 and 16 inches.

METHOD OF INJECTION.

Special instruments are made for this purpose, the most useful being the Vermorel Injector (Fig. 126); by means of this instrument a large amount of ground can be got over very rapidly.

A man and a boy can easily make 3,000 injections a day, and about 6,000 are required per acre if the whole land has to be treated; but in case of fruit plantations this is much reduced, owing to the immediate neighbourhood of the trees only needing attention.

USES.

The fumes of the bisulphide of carbon are useful in destroying maggots and the larvae of all insects in the soil, and also such adults as ground aphides as they come in contact with.

So far no effect has been noticed on pupae or puparia. Amongst the pests which have been shown to be killed by this treatment are the larvae of weevils, sawfly, chafers, click beetles; the pear midge, and various aphides, as the phylloxera, woolly aphis, and currant root louse. Ants are also killed by this treatment.

TIME OF APPLICATION.

This is best done when the trees are regaining activity and when the land is fairly but not too moist. It should not be done when trees are flowering or fruiting, as it produces under certain circumstances a check in growth. It is best to inject it here in March, before the buds open, or in late autumn.

The growth of plants after treatment is unusually good.

PYRETHRUM.

This is only used as a fumigant for plants under glass, and has not been applied to fruit; but for peach aphid it might well be tried, as it is very deadly to these insects.

TOBACCO.

This is also an excellent fumigant, and is used in connection with fruit under glass. There are various preparations of tobacco for fumigating on the market which may be obtained from nurserymen and dealers.

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Messrs. Carless, Capel & Leonard, Hope Chemical Works, Hackney Wick, London, N.E. Solar Distillate Oil, etc.

The Chemical Union, Ltd., Ipswich, Suffolk. Insecticides and chemicals for washes.

The Chiswick Soap Co., Chiswick, London, S.W. Soft soaps for aphides, etc.

Mr. Herrod, Chemist, Wisbech. Chemicals for insecticides, etc.

Messrs. McDougall Brothers, 66 and 68, Port Street, Manchester. Summer washes for insects and acari. Paraffin jelly.

Messrs. Renny, Forbes & Co., Ltd., Alperton, Wembley, N.W. Pure insecticidal and fungicidal chemicals and grease and grease-proof paper.

Messrs. Strawson & Co., 71a, Queen Victoria Street, E.C. Chemicals for insecticides and acaricides. Agents for Swift's Arsenate of Lead Paste.

United Alkali Co., Liverpool. Caustic soda, caustic potash, etc., and ready mixed caustic soda and potash.

Messrs. Voss & Co., Millwall, London. Makers of the Woburn insecticides; nicotine washes and chemicals.

Mr. D. M. Watson, 61, South Gt. George Street, Dublin, Ireland. Pure insecticidal chemicals. Irish agent for Swift's Arsenate of Lead.

Messrs. Corfe & Son, 5, St. Gabriel's Hill, Maidstone. Pure insecticidal chemicals.

Messrs. Cooper & Nephews, Berkhamsted. Insecticides, etc.

B.—SPRAYING MACHINES, ETC.

Messrs. Clarke & Co., Great St. Helens, E.C. Agents for Vermorel injectors and Medusa lamps, etc.

Messrs. Drake & Fletcher, Engineers, Maidstone, Kent. Spraying apparatus of all kinds.

The Four Oaks Undentable Syringe and Spraying Machine Co., Sutton Coldfield, Birmingham. Hand syringing, knapsack and other spraying machines.

Messrs. Merryweather & Sons, Greenwich Road, London, S.E. Steam spraying apparatus.

Messrs. Strawson & Co., 71a, Queen Victoria Street, E.C. Knapsack and other spraying machines.

Messrs. Sutton & Sons, Reading. Pruning shears for removing caterpillar nests and egg-masses.

Messrs. White & Co., Beltring, Paddock Wood, Kent. Abol sprayers for bush fruit and garden use ; also makers of insecticides.

C.—FUMIGATING APPARATUS.

Messrs. J. P. Campbell & Co., 185, Water Street, Manchester. Sulphur fumigating apparatus.

F. C. Edwards & Co., Nurserymen, Warehouse Hill, Leeds. Hydrocyanic acid gas apparatus.

N.B.—In all cases the author strongly advises growers to buy British-made spraying apparatus, as it is far better and more durable than any other spraying outfits on the market.

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The Syringe is an excellent instrument. With the finest nozzle a perfect mist is formed, which does not fall quickly but hangs in the air, and consequently settles upon upper and under surfaces alike; this has hitherto been a desideratum. The drip protector makes overhead spraying a pleasure instead of a terror.

The Insecticide at its weakest proportion indicated, destroys aphides (green fly), **Rose mildew**, and the **American Gooseberry mildew**. No scorching has followed the use of the strongest solution indicated when applied to very delicate foliage.—Yours truly,

(Signed) **GEO. MASSEE, V.M.H., F.L.S., &c.,**
Joint Author of "*The Enemies of the Rose*,"
issued by the National Rose Society.

May be had through all SEEDSMEN, FLORISTS and IRONMONGERS;

Or, on receipt of remittance, from the Sole Proprietors and Manufacturers,

**E. A. WHITE, Ltd., Paddock Wood, KENT,
Hop and Fruit Growers.**

Telegrams:
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"ACME" WEED KILLER

FOR DESTROYING WEEDS, MOSS, &c., ON CARRIAGE DRIVES,
GARDEN WALKS, ROADS, &c.

POWDER WEED KILLER.

DISSOLVES QUICKLY IN COLD WATER.

Size of Tins.	No. 1	To make 25 gallons	... ...	1/9 ; postage 3d.
	No. 2 "	50	"	3/3 ; , 4d.
	No. 3 "	100	"	6/- ; post paid.

LIQUID. Strength 1 in 25 and 1 in 50.

WINTER WASH for Fruit Trees. Formula recommended by Board of Agriculture.

SOLUBLE PARAFFIN—Mixes instantly with water, and does not separate.

ARSENATE OF LEAD for destroying all leaf-eating insects.

"**FUMERITE**" for destroying all ground vermin. To be dug into the soil.

EXTRACT OF QUASSIA. **QUASSIA CHIPS.**

COMPOUND EXTRACT OF QUASSIA AND SOFT SOAP.

SUMMER SHADING. &c. **BONES,** $\frac{1}{2}$ inch, $\frac{1}{4}$ inch. **BONE MEAL.**

CAUSTIC SODA, pulv., 98 %. **SULPHATE OF COPPER**, 98 %.

LIVER OF SULPHUR, &c., &c. **GREASE AND PAPER BANDS FOR TREES.**

Prices and particulars on application.

THE ACME CHEMICAL CO., Ltd.,
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Hop Washing and Fruit Spraying Machines, Sulphurators,
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TO BE WORKED BY

Hand-Power, Horse, Cattle, Petrol, Oil or Steam Engines.

CASTINGS of every description to the Trade, etc. Private Lighting
Installations—Electric, Acetylene. Special Quotations for Petrol, Oil, etc.

Send for Copy of **Fruit Growers' Manual.**

In Orchard, Garden, and Greenhouse, use

NICOTINE INSECTICIDES

For killing Green and Black Fly, Thrip, Scale, Psylla, Caterpillar, Woolly Aphis, &c.
They are perfectly safe, instantly soluble, and do not clog or affect spraying machines
in any way.

Mr. SPENCER PICKERING, F.R.S., Principal of the Duke of Bedford's Experimental Fruit Farm, at Woburn, in addressing a Conference of the Kent and Surrey Fruit Growers held at the South-Eastern Agricultural College, Wye, said he had found that for Psylla a solution containing 0·075 per cent. (1 part in 1,333 of water) of nicotine was in all cases efficacious, and that the occurrence of light rain within a few hours of spraying did not nullify that effect.

BEING ACTUAL MANUFACTURERS IN BOND,

from duty-free tobacco, we can quote very favourably for either pure Nicotine, or Nicotine Spraying, Vaporising, or Fumigating Compounds.

The King of Insecticides.

CAMPBELL'S NICO-SOAP.

Makes a splendid Insecticide for spraying to destroy Green and Black Fly, Apple Sucker, Thrip, Mealy Bug, American Blight, Caterpillars, Cankerworms, Scale, &c. Is perfectly safe on all kinds of foliage, and exceedingly economical, since

1 part makes 400 to 600 parts spraying solution.

It is the Insecticide of the future, and must supersede such washes as Paraffin, Quassia, Paris Green, &c. We have recently executed one order alone for

FOUR THOUSAND LBS.

USERS say:-

HORTICULTURAL EXPERIMENTAL STATION,
Under the direction of the Ontario Agricultural College, Guelph, Jordan Harbour,
September 4th, 1908.

I may say that we used Campbell's Nico-Soap for San José Scale on badly-infested plum trees. While the effects were slightly less satisfactory than on the trees sprayed with Lime Sulphur Wash, the ease with which the Soap may be applied and the improved appearance of the trees would be a strong factor in recommending its use.

While we did not have the opportunity of trying this Soap when the young Scale were running, my observation on the tree sprayed in June for Oyster Shell Scale will prove that this Soap will yet be valuable for San José Scale. We used it for the treatment of Aphis and found it most satisfactory.

As we were somewhat handicapped this year for equipments, we were not able to give as much attention to this work as desired. However, we have everything in good shape now to continue next year, when we hope to be able to give you something of a more definite nature.

(Signed) H. P. PEART, *Director.*

The Royal Horticultural Society report in their Journal for March, 1909, p. 551:-

NICO-SOAP (Campbell's).—An excellent Insecticide if used according to directions, killing Aphis, Thrips, or Red Spider, without any injury to the foliage.

CAMPBELL'S BORDEAUX MIXTURE.

For spraying Fruit Trees, Potato and other crops, to prevent and cure Mildew, Blight, Spot, and other Disease attacks.

This preparation has been introduced to meet the modern demand for rapidity, and economy of time. It is vastly superior to the home-made article, and can always be depended upon to be the same quality (a very strong feature, you must admit). A 40-gallon cask can be prepared in a few minutes. It is composed of absolutely pure materials, finely ground, making it almost instantly soluble and quite free from particles of grit—advantages which are almost impossible to secure for the same money when the Bordeaux is home-made.

CAMPBELL'S CAUSTIC ALKALI WASH.

For washing dormant Fruit Trees to destroy Mosses and Lichens growing on the bark, Mealy Bug, American Blight, Red Spider, Codlin Moth Maggot, and all other lurking insects, their Nests and Eggs, without damage to the trees.

CAMPBELL'S PATENT SULPHUR VAPORISER.

Best Remedy extant for combating Mildew and Diseases of Plants in Greenhouses.

COPPER SULPHATE, CAUSTIC SODA, LIVER OF SULPHUR, &c.

Particulars and Prices on application.

**Exors. ROBERT CAMPBELL,
WATER STREET, MANCHESTER.**

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= and Analytical Chemists, =

MILLWALL, LONDON.

WOBURN WINTER WASH. (For all Fruit Trees.)

WOBURN TOBACCO EXTRACT.

(For Psylla and Aphis.)

WOBURN BORDEAUX PASTE. A great improvement upon Bordeaux Mixture; only just out, and already approved by Mr. Spencer Pickering, F.R.S.

WOBURN EMULSION. (For Summer Spraying.)

LIVER OF SULPHUR. (For Fungoid Diseases.)

CARLTON ARSENATE OF LEAD PASTE. (For Caterpillar on Fruit Trees.)

CARLTON BANDING GREASE. (For Winter Moths.)

PHOSPHO NICOTYL. (The only Cure for Woodlice.)

NICOTYL FUMIGATING COMPOUND. (For Aphis &c., under glass.)

**PERMANGANATE OF
POTASH.**

**SULPHATE OF COPPER,
98/99%.**

CARBOLIC ACID.

FLOWERS OF SULPHUR.

NAPTHALENE.

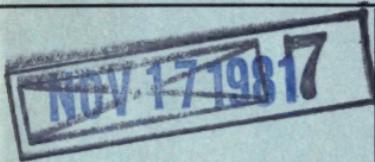
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